Iskra®

User's Manual

GB¶

Quality Analyser MC774

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SECURITY ADVICE AND WARNINGS

Please read this chapter carefully and examine the equipment carefully for potential damages which might arise during transport and to become familiar with it before continue to install, energize and work with a measuring instrument.

This chapter deals with important information and warnings that should be considered for safe installation and handling with a device in order to assure its correct use and continuous operation.

Everyone using the product should become familiar with the contents of chapter »Security Advices and Warnings«.

If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

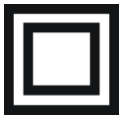
PLEASE NOTE

By qualified personnel only. ISKRA Company assumes no responsibility in connection with installation This booklet contains instructions for installation and use of measuring instrument. Installation and use of a device also includes handling with dangerous currents and voltages therefore should be installed, operated, serviced and maintained and use of the product. If there is any doubt regarding installation and use of the system in which the device is used for measuring or supervision, please contact a person who is responsible for installation of such system.

Installation and use of devices also includes work with dangerous currents and voltages, therefore such work shall be carried out by qualified persons. The ISKRA SISTEMI Company assumes no responsibility in connection with installation and use of the product. If there is any doubt regarding installation and use of the system in which the instrument is used for measuring or supervision, please contact a person who is responsible for installation of such system.

Warnings, information and notes regarding designation of the product

Used symbos:

	See product documentation.
	Double insulation in compliance with the EN 61010−1standard.
	Functional ground potential. Note: This symbol is also used for marking a terminal for protective ground potential if it is used as a part of connection terminal or auxiliary supply terminals.
	Compliance of the product with directive 2002/96/EC, as first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment.
	Compliance of the product with European CE directives.

Before switching the device ON

Check the following before switching on the device:

- Nominal voltage,
- Supply voltage,
- Nominal frequency,
- Voltage ratio and phase sequence,
- Current transformer ratio and terminals integrity,
- Protection fuse for voltage inputs (recommended maximal external fuse size is 6 A)
- External switch or circuit-breaker must be included in the installation for disconnection of the devices' aux. power supply. --It must be suitably located and properly marked for reliable disconnection of the device when needed.
- Integrity of earth terminal
- Proper connection and voltage level of I/O modules

Important: A current transformer secondary should be short circuited before connecting the device.

WARNING!

Auxiliary power supply can be LOW range (19-70VDC, 48-77VAC). Connecting device with LOW power supply to higher voltage will cause device malfunction. Check devices' specification before turn it on!

Real time clock

As a backup power supply for Real time clock supercap is built in. Support time is up to 2 days (after each power supply down).

Disposal

It is strongly recommended that electrical and electronic equipment is not deposit as municipal waste. The manufacturer or provider shall take waste electrical and electronic equipment free of charge. The complete procedure after lifetime should comply with the Directive 2002/96/EC about restriction on the use of certain hazardous substances in electrical and electronic equipment.

BASIC DESCRIPTION AND OPERATION

The following chapter presents basic information about MC774 Quality Analyser required to understand its purpose, applicability and basic features connected to its operation.

Besides that, this chapter contains navigational tips, description of used symbols and other useful information for understandable navigation through this manual.

Regarding the options of a Quality Analyser, different chapters should be considered since it might vary in functionality and design. More detailed description of device functions is given in chapter Main Features, supported options and functionality.

Quality Analyser MC774 is available in housing for panel mounting. Specifications of housing and panel cut out for housing is specified in chapter Dimensions.

Contents

Contents and size of a packaging box can slightly vary depending on type of consignment.

Single device shipment or a very small quantity of devices is shipped in a larger cardboard box, which offers better physical protection during transport.

This type of contents contains::

-Measuring instrument

-Fixation screws

-Pluggable terminals for connection of inputs, aux. Power supply and I/O modules

-CD with full version of this document, installation of setting software MiQen, required drivers for -USB (if device is equipped witd USB communication)

-Short installation manual

When larger amount of devices is sent they are shipped in a smaller cardboard box for saving space and thus reducing shipment costs. This type of contents contains:

-Measuring instrument

-Fixation screws

-Pluggable terminals for connection of inputs, aux. Power supply and I/O modules

-Short installation manual

This document and settings software MiQen can also be found on our web page http://www.iskra.eu/.

CAUTION

Please examine the equipment carefully for potential damages which might arise during transport!

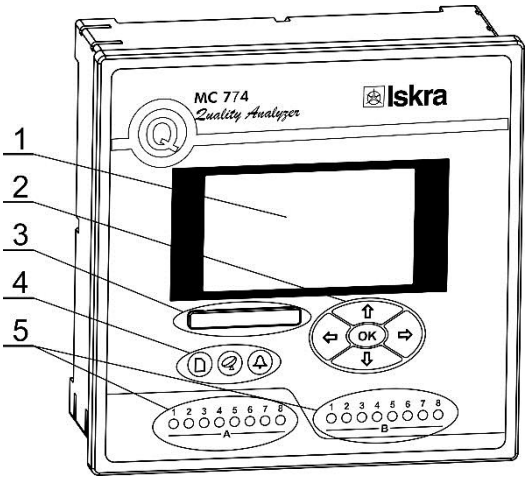
Description of the Quality Analyser

MC774 Quality Analyser is a comprehensive device intended for permanent monitoring of power quality from its production (especially renewable), transmission, distribution to final consumers, who are most affected by insufficient quality of voltage. It is mostly applicable in medium and low voltage markets.

Lack of information about supplied quality of voltage can lead to unexplained production problems and malfunction or even damage to equipment used in production process. Therefore, this device can be used for utility purposes (evaluation against standards) as well as for industial purposes (e.g. for monitoring supplied power quality).

Appearance

1- Graphical LCD
2- Navigation keyboard
3- A slot with a cover for memory card
4- General operation LED indicators (card/com./alarm)
5- I/O status LED indicators



Graphical LCD

A graphical LCD with back light is used for high resolution of displayed measuring quantities and for a display of selected functions when setting the device.

Navigation keyboard

The "OK" key is used for confirming the settings, selecting and exiting the display. Direction keys are used for shifting between screens and menus.

A slot with a cover Memory card

A Quality Analyser is provided with a slot for a full size MMC or SD card that is used for data transfer from the internal memory, device setting and software upgrading. A slot protection cover for the card prevents penetration of humidity and dust into device.

LED indicators

There are two types of LED indicators positioned on the front panel. General operation LED indicators and I/O status LED indicators.

General operation LED indicators warns of a certain state of the device. A left (red) indicator indicates the card activity and that it should not be pulled out. A middle (green) one is blinking when transmitting MC data via communication. A right (red) one is blinking when the condition for the alarm is fulfilled.

I/O state LED indicators are in operation when additional Modules A and/or B are built in and they have functionality of Digital input or Relay output. They are indicating the state of a single I/O. Red LED is lit when:

- Relay output is activated
- Signal is present on Digital input

Abbreviation/Glossary

Abbreviations are explained within the text where they appear the first time. Most common abbreviations and expressions are explained in the following table:

Term	*Explanation*
RMS	Root Mean Square value
Flash	Type of a memory module that keeps its content in case of power supply failure
Ethernet	IEEE 802.3 data layer protocol
MODBUS / DNP3	Industrial protocol for data transmission
Memory card	Multimedia memory card. Type MMC and SD supported.
MiQen	Setting Software for Iskra SISTEMI instruments
PA total	Power Angle calculated from total active and apparent power
PA_{phase}	Angle between fundamental phase voltage and phase current
PF_{phase}	Power factor, calculated from apparent and active power (affected by harmonics)
THD (U, I)	Total harmonic distortion
MD	Max. Demand; Measurement of average values in time interval
FFT graphs	Graphical display of presence of harmonics
Harmonic voltage – harmonic	Sine voltage with frequency equal to integer multiple of basic frequency
InterHarmonic voltage – interharmonic	Sine voltage with frequency NOT equal to integer multiple of basic frequency
Flicker	Voltage fluctuation causes changes of luminous intensity of lamps, which causes the so-called flicker
RTC	Real Time Clock
Sample factor	Defines a number of periods for measuring calculation on the basis of measured frequency
M_p – Average interval	Defines frequency of refreshing displayed measurements
Hysteresis [%]	Percentage specifies increase or decrease of a measurement from a certain limit after exceeding it.
IRIG-B	Serial Inter-range instrumentation group time code
GPS	Satellite navigation and time synchronisation system
PO	Pulse output module
TI	Tariff input module
RO	Relay output module
BO	Bistable alarm output module
AO	Analogue output module
DI	Digital input module
PI	Pulse input module
AI	Analogue input module

WO	Status (watchdog) module – for supervision of proper operation

List of common abbreviations and expressions

Purpose and use of the device

MC774 Quality Analyser performs measurements in compliance with regulatory requested standard EN 61000-4-30 and evaluates recorded parameters for analysis according to parameters defined in European supply quality standard EN 50160:2011.

Moreover device stores measurements and quality reports in internal memory for further analysis over recorded measurements. From multiple devices installed on different locations, user can gain the overall picture of system behaviour. This can be achieved with regard to its accurate internal real time clock and wide range of synchronization sources support, which assure accurate, time-stamped measurements from dislocated units.

All required measurements, weekly PQ reports and alarms can also be stored locally in an internal memory. Stored data can be then transferred to a memory card or accessed through communication for post analysis.

The internal memory capacity enables storing of more than 170,000 variations of the measurements from the standard values, which enables finding eventual reasons for the problems in network. Limits and required quality in a monitored period can be defined for each monitored characteristic. The following characteristics are measured and recorded:

Power Quality indices as defined by EN 50160

Phenomena	*PQ Parameters*
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation
	Voltage unbalance
Voltage changes	Rapid voltage changes
	Flicker
Voltage events	Voltage dips
	Voltage interruptions
	Voltage swells
Harmonics & THD	THD
	Harmonics
	Inter-harmonics
	Signalling voltage

Main Features, supported options and functionality

MC774 Quality Analyser is a perfect tool for monitoring and analysing medium or low voltage systems in power distribution and industrial segments. It can be used as a standalone PQ monitoring device for detection of local PQ deviations. For this purpose it is normally positioned at the point-of-common-coupling (PCC) of small and medium industrial and commercial energy consumers to monitor quality of delivered electric energy or at medium or low voltage feeders to monitor, detect and record possible disturbances caused by (unauthorized) operation of consumers.

User can select different hardware modules that can be implemented in device. Wide range of variants can cover practically every user's requirements.

MC774 Quality Analyser is a compact, user friendly and cost effective device that offers various features to suit most of the requirements for a demanding power system management:

-PQ analysis in compliance with EN 50160 with automatic report generation

-High accuracy in compliance with Class A (0.1%) EN61000-4-30

-Measurements of instantaneous values of more than 140 quantities including harmonics, flicker, power line signalling voltage, unbalance…

-Four quadrant energy measurement with class 0.2S for active energy, 8 programmable counters, up to four tariffs, tariff clock…

-Recording all measured parameters including all voltage and current harmonics up to 65^{th}, 32 adjustable alarms, anomalies and quality reports in the internal memory

-Automatic range selection of 4 current and 4 voltage channels (max. 12.5 A and 1000 Vrms) with 32 kHz sampling rate

-MODBUS and DNP3 communication protocols

-Support for effective sub metering applications (comprehensive counters settings, tariff and cost management)

-Support for GPS, IRIG-B (modulated and digital) and NTP real time synchronisation

-Up to 20 inputs and outputs

-Multilingual support

-User-friendly setting and evaluation software, MiQen

-CE certification

General hardware Features	*Default / Optional*
General	
Class A measuring accuracy according to EN 61000-4-30	●
Voltage auto range up to 1000Vp-ρ_{RMS}	●
Current auto range up to 12.5 A	●
4 voltage and 4 current channels with 32 us sampling time	●
Universal power supply type High or type Low	● / ○
Two independent communication ports (see data below)	○
Support for GPS, IRIG-B and NTP real time synchronisation	● / ● / ○
Up to 20 additional inputs and outputs (see data below)	○
Internal flash memory (8MB)	●
Real time clock (RTC)	●
standard 144 mm DIN square panel mounting	●
Front panel	
Graphical LCD display with back light	●
LED indicator (card/com./alarm)	●
I/O status LED indicator	●
SD memory card slot for data transfer	●
Control keys on front panel (5 keys)	●
Communication	
COM1: Ethernet +USB / USB / Serial (RS232/485)	● / ○ / ○
COM2: Serial (RS232/ RS485 on slot C if other synchronisation modes are in use)	●

● − Function is supported (default)
○ − Optional (to be specified with an order)

General hardware Features	*Default / Optional*
Input and output modules	
Input / output module 1	
2×AO / 2×AI / 2×RO / 2×PO / 2×PI / 2×TI / 1×BO / 2×DI / WO+RO	○/○/○/○/○/○/○/○/○
Input / output module 2	
2×AO / 2×AI / 2×RO / 2×PO / 2×PI / 2×TI / 1×BO / 2×DI / WO+RO	○/○/○/○/○/○/○/○/○
Auxiliary input / output module A	
I/O A (1-8) DI / RO	○ / ○
Auxiliary input / output module B	
I/O B (1-8) DI / RO	○ / ○
Synchronisation module C	
I/O C GPS + 1pps / IRIG-B / COM2	● / ● / ●

● Function is supported (default)
○ Optional (to be specified with an order)

PO Pulse output module
TI Tariff input module
RO Relay output module
BO Bistable relay output module
AO Analogue output module
DI Digital input module
PI Pulse input module
AI Analogue input module – U, I or R (PT100/1000)
WO Status (watchdog) module – for supervision of proper operation

General software Features	*Default / optional*
Setup wizard	●
Wrong connection warning	●
Custom screen settings (3 user defined screens on LCD)	●
Demonstration screen cycling	●

Programmable refresh time	●
MODBUS and DNP3 communication protocols	●
Tariff clock	●
MD calculation (TF, FW, SW)	●
Wide frequency measurement range 16 – 400 Hz	●
Programmable alarms (32 alarms)	●
Alarms recording	●
Measurements recording (128 quantities)	●
Measurements graphs (time / FFT)	●
Evaluation of voltage quality in compliance with EN 50160	●
Real time clock synchronisation (GPS/IRIG-B/NTP)	●

CONNECTION

This chapter deals with the instructions for measuring instrument connection. Both the use and connection of the device includes handling with dangerous currents and voltages. Connection shall therefore be performed ONLY a by a qualified person using an appropriate equipment. Iskra Sistemi d.d. does not take any responsibility regarding the use and connection. If any doubt occurs regarding connection and use in the system which device is intended for, please contact a person who is responsible for such installations.

A person qualified for installation and connection of a device should be familiar with all necessary precaution measures described in this document prior to its connection.

Before use:

Before use please check the following:

- Nominal voltage ($U_{P\text{-}Pmax}$ = 1000V_{ACrms}; $U_{P\text{-}Nmax}$ = 600V_{ACrms}),
- Supply voltage (type HIGH or type LOW),
- Nominal frequency,
- Voltage ratio and phase sequence,
- Current transformer ratio and terminals integrity,
- Protection fuse for voltage inputs (recommended maximal external fuse size is 6 A)
- External switch or circuit-breaker must be included in the installation for disconnection of the devices' aux. power supply. It must be suitably located and properly marked for reliable disconnection of the device when needed. See CAUTION below.
- Integrity of earth terminal
- Proper connection and voltage level of I/O modules

WARNING!

Wrong or incomplete connection of voltage or other terminals can cause non-operation or damage to the device.

WARNING!

It is imperative that terminal 12 which represents fourth voltage measurement channel is connected to earth pole ONLY. This terminal should be connected to EARTH potential at all times! This input channel is used only for measuring voltage between neutral end earth line.

CAUTION

Aux. Supply inrush current can be as high as 20A for short period of time
(<1 ms). Please choose an appropriate MCB for disconnection of aux. Supply.

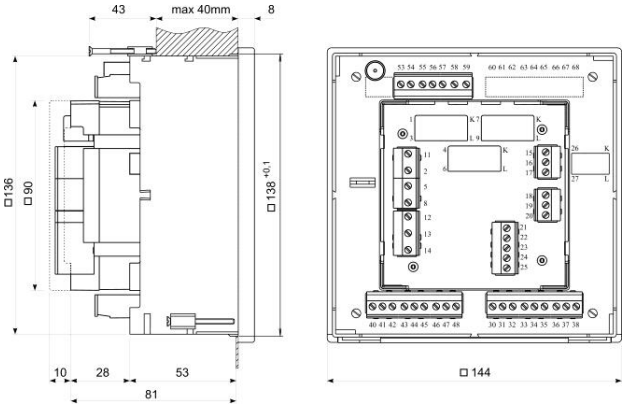
PLEASE NOTE

After connection, settings have to be performed via a keyboard on the front side of the device that reflect connection of device to voltage network (connection mode, current and voltage transformers ratio …). Settings can also be done via communication or a memory card (where available).

Mounting MC774

MC774 Quality Analyser is intended only for panel mounting. Pluggable connection terminals allow easier installation and quick replacement should that be required.

This device is not intended for usage as portable equipment and should be used only as a fixed panel mounted device.



Dimensional drawing and rear connection terminals position

Recommended panel cut out is:
138 x 138 mm + 0.8
Please remove protection foil from the screen.

Electrical connection for MC774

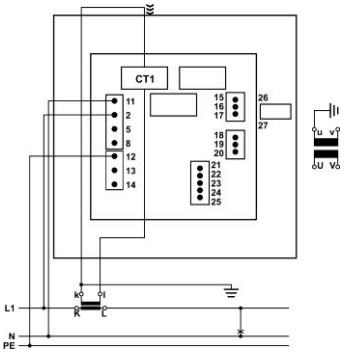
Voltage inputs of a device can be connected directly to low-voltage network or via a voltage measuring transformer to a high-voltage network.

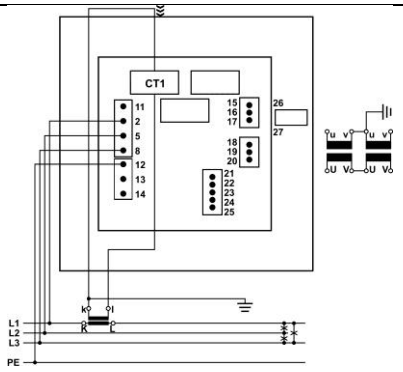
Current inputs of a device are led through a hole in current transformers to allow uninterrupted current connection. Connection to network is performed via a corresponding current transformer.

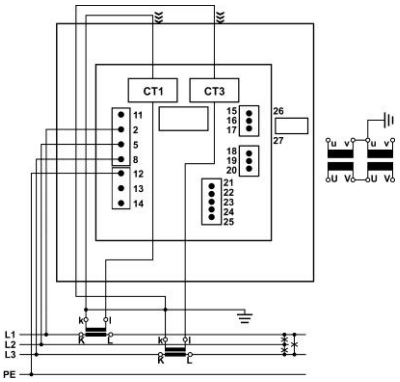
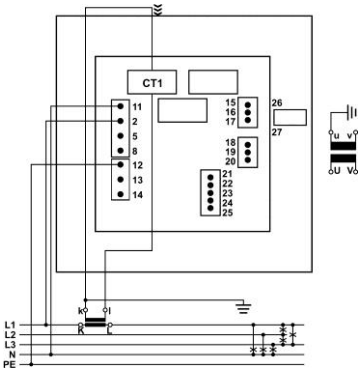
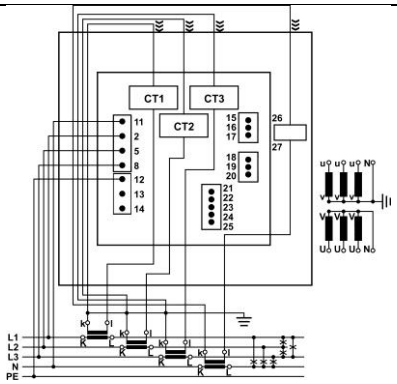
Choose corresponding connection from the figures below and connect corresponding voltages and currents. Information on electrical consumption of current and voltage inputs is given in a chapter I/O modules.

CAUTION

For accurate operation and to avoid measuring signal crosstalk it is important to avoid driving voltage measuring wires close to current measuring transformers.

System/ connection	*Terminal assignment*
Connection 1b (1W) *Single-phase connection*	
Connection 3b (1W3) *Three-phase – three-wire connection with balanced load*	

	 CT1 11 2 5 8 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 k l L1 L2 L3 PE

Connection 3u (2W3) *Three-phase – three-wire connection with unbalanced load*	
Connection 4b (1W4) *Three-phase – four-wire connection with balanced load*	
Connection 4u (3W4) *Three-phase – four-wire connection with unbalanced load*	

PLEASE NOTE

Examples of connections are given for device with built in two input / output modules and RS232 / RS485 communication. Connection does not depend on a number of built-in modules and communication, and is shown on the device's label.

Connection of input/output modules for MC774

WARNING!

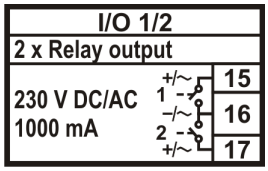
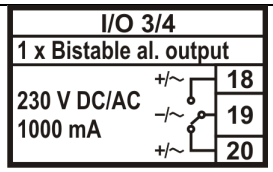
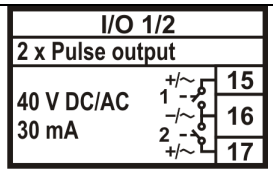
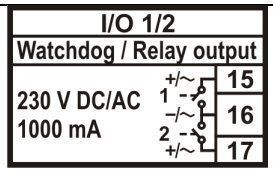
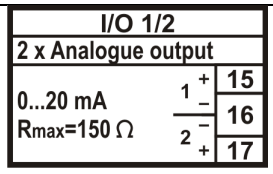
Check the module features that are specified on the label, before connecting module contacts. Wrong connection can cause damage or destruction of module and/or device.

PLEASE NOTE

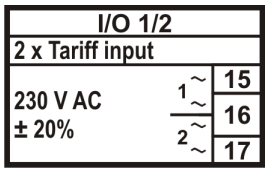
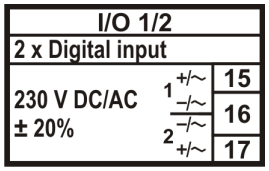
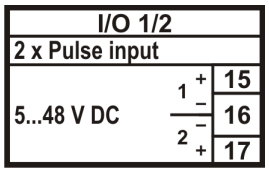
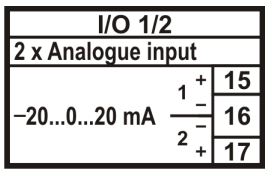
Examples of connections are given for device with built in two input / output modules and RS232 / RS485 communication. Connection does not depend on a number of built-in modules and communication, and is shown on the devices' label.

Connect module contacts as specified on the label. Examples of labels are given below and describe modules built in the device. Information on electrical properties of modules is given in a chapter I/O modules.

I/O module 1 and 2 *(terminal numbers 15-20)* ***– output options***

	Alarm (relay) output module with two outputs.
	Bistable alarm output module; keeps the state also in case of device power supply failure.
	Pulse output (solid state) module with two pulse outputs for energy counters.
	Status (watchdog) output module enables proper device operation supervision on one output (WD) and alarm output functionality on the other.
	Analogue output module with two analogue outputs (0…20mA), proportional to measured quantities.

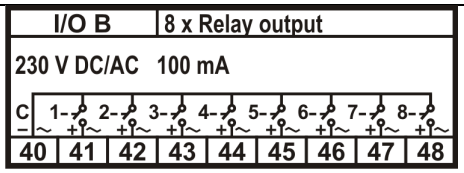
I/O module 1 and 2** (terminal numbers 15-20) **– input options

	Tariff input module with two tariff inputs for changeover between up to four tariffs.
	Digital input module with two digital inputs enables reception of impulse signals.
	Pulse input module enables reception of pulses from various counters (water, gas, heat, flow
	Analogue input module enables measurements of DC U, I, R or temp. (PT100, PT1000) values from external sources. Modules have different hardware, so programming is possible within one quantity.

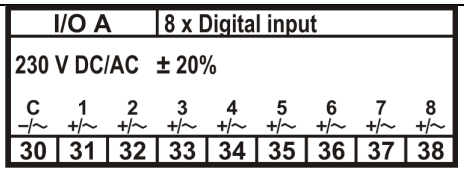
WARNING

In case when only one resistance-temperature analogue input is used, the other must be short-circuited.

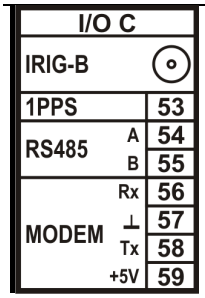
Auxiliary I/O module A and B – output options

	Digital output relay module with eight digital outputs enables alarm functionality.

Auxiliary I/O module A and B – input options

	Digital input module with eight digital inputs enables reception of digital signals.

Synchronisation module C



Synchronisation module is equipped with support for two different synchronisation methods IRIG-B and GPS modem.

When modulated IRIG-B signal is used it should be connected to BNC terminal. When level-shift IRIG-B signal is used it should be connected to 1PPS terminal.

In case of GPS modem, 1pps signal should be connected to 1PPS terminal and serial RS232 signal should be connected to RS232 terminals.

When IRIG-B (modulated or level-shift) or 1PPS signal is used for time synchronisation serial communication interface (RS232 or RS485) can be used as a devices' secondary communication port (COM2).

PLEASE NOTE

Communication port on Module C is primarily dedicated to receive serial coded date and time telegram from a GPS receiver in order to synchronise internal real time clock (RTC). When other methods are used for synchronising RTC this communication port can be used as a secondary general purpose communication port.

Please note that either RS232 or RS485 should be used and not both at a time. Connector terminals that are not used should remain unconnected otherwise the communication could not work properly.

CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

CAUTION

Max consumption of +5V supply terminal is 100mA. When GPS with consumption greater the 100mA is used it is advisable to use external power supply.

Memory card

MC7XX is equipped with a front panel slot for a SD memory card that supports capacity up to 2 GB.

CAUTION

When memory slot is not used it should be covered with attached cover to avoid penetration of dust and small objects.

Memory card is useful for transferring stored data and performing other system operations (downloading settings, firmware update) when device is not connected to communication.

Memory card allows different operations. Immediately after insertion of a memory card devices' menu changes to show memory card options

Transferring data stored in internal memory

All data (readings, alarms, PQ reports and details), which are stored in internal memory can be transferred to a memory card.

PLEASE NOTE

Measurements cannot be directly recorded to a memory card. Only data previously stored in internal memory can be transferred to a memory card.

Upload and download settings

This is a very convenient way of programming devices. Settings can be manually programmed once and stored to a memory card by *Upload settings*. Using that memory card more devices can be programmed very fast with identical settings.

Firmware update

When new features are added or when certain fixes should be implemented it is necessary to update devices' firmware. This can again be performed fastest by using memory card. New firmware should be transferred to a memory card from computer once. After that multiple devices can be updated only with memory card.

CAUTION

During firmware update aux. power supply must not be interrupted.

Communication connection for MC774

Primary communication interface (COM1) type is normally specified when placing an order. Device can support several types of communication:

-serial RS232/ 485 communication designed as a pluggable 5-pole screw terminal connector,

-Ethernet communication designed as standard RJ-45 terminal and USB communication designed as standard USB-B type terminal

-Single USB communication designed as standard USB-B type terminal

PLEASE NOTE

When connecting serial communication please note that only RS232 or RS485 should be used and not both at a time. Connector terminals that are not used should remain unconnected otherwise the communication could not work properly.

Beside primary communication port the device has built in a secondary communication port (COM2) as a part of a real time synchronisation module C. Its operation is described in a chapter referring to a real time synchronisation Serial communication via Synchronisation module C (COM2).

Connect a communication line by means of a corresponding terminal. Communication parameters are stated on the device label, regarding the selected/equipped type of communication. Connector terminals are marked on the label on a devices' rear side. More detailed information on communication is given in chapter *Communication.*

COMMUNICATION TERMINAL **RS485** **RS232** A B Rx ⊥ Tx 21 22 23 24 25	Example of a label for RS232 and RS485 communication with a pluggable screw terminal connector
COMMUNICATION Ethernet MAC No.: 00-1B-DF-54-7B-4A USB 2.0 Type B	Example of a label for Ethernet/USB communication module equipped with RJ−45 and USB-B type connector
COMMUNICATION USB 2.0 Type B	Example of a label for USB communication with USB-B type connector

Communicaton connection RS232

RS232 communication is intended for direct connection of the Measuring centre to the personal computer. For proper operation it is necessary to assure the corresponding connection of individual terminals (see table: Survey of communication connection).

Serial RS232 as secondary communication, COM2 additional communication module
Operates as an independent communication. Separate communication parameters can be set for this communication module.

Communicaton connection RS485

RS485 communication is intended for connection of devices to network where several devices with RS485 communication are connected to a common communication interface. We suggest using one of the Iskra Sistemi d.d. communication interfaces! For proper operation it is necessary to assure the corresponding connection of individual terminals (see table on next page).

Serial RS485 as secondary communication, COM2 additional communication module
Operates as an independent communication. Separate communication parameters can be set for this communication module.

Communication for Analogue extender EX104, COM2 additional communication module
Operates as an predefined RS485 communication that can be used for data transfer between measuring centre and analogue extenders EX104.

Ethernet

Ethernet communication is used for connection of device to the Ethernet network for remote operation. Each device has its own MAC address that at some cases needs to be provided and is printed on the label on the device.

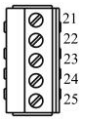
USB

USB communication serves as a fast peer-to-terminal data link. The device is detected by host as a USB 2.0 compatible device. The USB connection is provided through a USB standard Type B connector.

PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver is provided on the CD, enclosed in the original shipment package, or can be downloaded from the Iskra Sistemi web page www.iskrasistemi.si. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen software.

Survey of communication connection MC774

	Connector	*Terminals*	*Position*	*Data direction*	*Description*
RS485 RS232	Screw terminal		21	To/From	A
			22	To/From	B
			23	To	Data reception (Rx)
			24	–	Grounding (⏚)
			25	From	Data transmission (Tx)
Ethernet	RJ−45		100BASE-T CAT5 cable recommended		
USB	USB-B		Standard USB 2.0 compatible cable recommended (Type B plug)		

Connection of Real Time Synchronization module C

Synchronized real-time clock (RTC) is an essential part of any Class A analyzer for proper chronological determination of various events. To distinct cause from consequence, to follow a certain event from its origin to manifestation in other parameters it is very important that each and every event and recorded measurement on one instrument can be compared with events and measurements on other devices. Even if instruments are dislocated, which is normally the case in electro distribution network events have to be time-comparable with accuracy better than a single period.

Synchronisation module is used to synchronise RTC of the device and to maintain its accuracy for correct aggregation intervals and time stamps of recorded events appearing in monitored electro distribution network.

Different types of RTC synchronisation are possible:

- IRIG-B modulated; 1 kHz modulation with <1ms resolution.
- IRIG-B unmodulated (level shift)
- 1PPS + RS232 Date & Time telegram (from GPS)

PLEASE NOTE

For safety purposes it is important that all three wires (Line, Neutral and Protective Earth) are firmly connected. They should be connected only to the designated terminals as shown on the label above as well as on the front foil.

GPS time synchronization:

1pps and serial RS232 communication with NMEA 0183 sentence support. GPS interface is designed as 5 pole pluggable terminal (+5V for receiver supply, 1pps input and standard RS232 communication interface). Proposed GPS receiver is GARMIN GPS18x

IRIG time code B (IRIG-B):

Unmodulated (DC 5V level shift) and modulated (1 kHz) serial coded format with support for 1pps, day of year, current year and straight seconds of day as described in standard IRIG-200-04. Supported serial time code formats are IRIG-B007 and IRIG-B127

Interface for modulated IRIG-B is designed as BNC-F terminal with 600 Ohm input impedance. Interface for unmodulated IRIG-B is designed as pluggable terminal (*see table 3*).

Network time protocol (NTP):

Synchronization via Ethernet requires access to a NTP server.

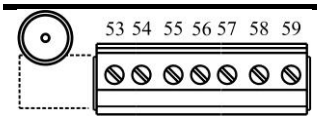
PLEASE NOTE

NTP can usually maintain time to within tens of milliseconds over the public Internet, but the accuracy depends on infrastructure properties - asymmetry in outgoing and incoming communication delay affects systematic bias. It is recommended that dedicated network rather than public network is used for synchronisation purposes.

CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

Survey of synchronisation *connection*

Terminals	*Connector type*
	BNC for modulated IRIG-B and Pluggable screw terminals for level-shift IRIG-B, GPS modem or serial RS232 or RS485

Connector	*Position*	*Data direction*	*Description*
BNC connector	600 Ohm input impedance: standard Coaxial cable (55 Ohm) recommended		
Screw terminal	53	1PPS (GPS) or IRIG-B (level shift)	Synchronisation pulse
	54	To/From (A)	RS485
	55	To/From (B)	RS485
	56	To	Data reception (Rx)
	57	GND	Grounding
	58	From	Data transmission (Tx)
	59	+5V	AUX voltage +5V (supply for GPS modem)

When IRIG-B or 1PPS signal is used for time synchronisation serial communication interface (RS232 or RS485) can be used as a devices' secondary communication port (COM2).

More information regarding use of Synchronisation module C is in a chapter *Synchronisation module C* and Serial communication via Synchronisation module C (COM2).

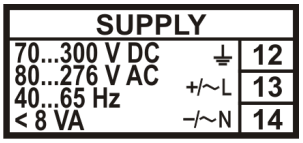
Connection of aux. Power supply

Device can be equipped with either of two types of universal (AC/DC) switching power supply.

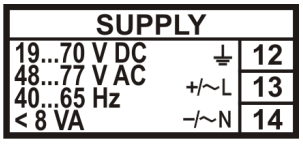
Type High: 70...300 V DC
80...276 V AC; 40...65 Hz

Type Low: 19...70 V DC
48...77 V AC; 40...65 Hz

Power supply voltage depends on ordered voltage. Information on electric consumption is given in chapter *Technical data* .
Regarding power supply voltage specification on the label, choose and connect the power supply voltage:



Connection of universal power supply type High to terminals 13 and 14.



Connection of universal power supply type Low to terminals 13 and 14.

WARNING!

Auxiliary power supply can be LOW range (19-70V_{DC}, 48-77V_{AC}). Connecting device with LOW power supply to higher voltage will cause device malfunction. Check devices' specification before turn it on!

CAUTION

Aux. supply inrush current can be as high as 20A for short period of time (<1 ms). Please choose an appropriate MCB for connection of aux. supply.

FIRST STEPS

Programming device is very transparent and user friendly. Numerous settings are organized in groups according to their functionality.

Programming device can be performed using the keypad and display on the front panel. Due to representation of certain settings not all settings can be programmed this way. All settings can be programmed using MiQen software.

In this chapter you will find basic programming steps which can be accessed by using keypad and display.

Installation wizard

After installation and electrical connection, basic parameters have to be set in order to assure correct operation. The easiest way to achieve that is use the Installation wizard. When entering the Installation menu, settings follow one another when the previous one is confirmed. All required parameters shall be entered and confirmed. Exit from the menu is possible when all required settings are confirmed or with interruption (key ⇐ several times) without changes.

Installation wizard menu may vary, depending on built in communication modules. In description below is marked which menu appears for specific option.

PLEASE NOTE!

All settings that are performed through the Installation wizard can be subsequently changed by means of the Settings menu or via MiQen by means of communication or a Memory card (where available).

When entering installation wizard following display is shown:

Installation
Welcome to the Installation Wizard. Press OK to continue.
< Main menu

Language

Set device language.

Date

Set device date.

Time

Set device time. If instrument is connected to one of supported time synchronisation sources, date and time are automatically set.

Connection mode

Choose connection from a list of supported connection modes.

Primary voltage

Set primary voltage of monitored system if a device is connected indirectly by means of a voltage transformer. If device is connected to directly to a low voltage enter this value.

Secondary voltage

Set secondary voltage if a voltage transformer is used; set voltage of low voltage network if connection is direct.

Primary current

Set primary current of monitored system if a device is connected indirectly by means of a current transformer. Otherwise primary and secondary current should remain the same.

Secondary current

Set secondary current of current transformer or the value of nominal current if connection is direct.

Common energy counter resolution

Define Common energy counter resolution as recommended in table below, where Individual counter resolution is at default value 10. Values of primary voltage and current determine proper Common energy counter resolution. For detailed information about setting energy parameters see chapter Energy.

Suggested Common energy counter resolutions:

Current / Voltage	1 A	5 A	50 A	100 A	1000 A
110 V	100 mWh	1 Wh	10 Wh	10 Wh	100 Wh
230 V	1 Wh	1 Wh	10 Wh	100 Wh	1 kWh
1000 V	1 Wh	10 Wh	100 Wh	1 kWh	10 kWh
30 kV	100 Wh	100 Wh	1 kWh	10 kWh	10 kWh *

* – Individual counter resolution should be at least 100

Device address

Set MODBUS address for the device. Default address is 33.

Baud rate

Set communication rate. Default rate is 115200 b/s. This setting is available only when RS232 / RS485 communication is built in.

Parity

Set communication parity. Default value is “None”. This setting is available only when RS232 / RS485 communication is built in.

Stop bit

Set communication stop bits. Default value is 2. This setting is available only when RS232 / RS485 communication is built in.

IP Address

Set correct IP address of the device. Default setting is 0.0.0.0 and represents DHCP addressing. This setting is available only when Ethernet communication is built in.

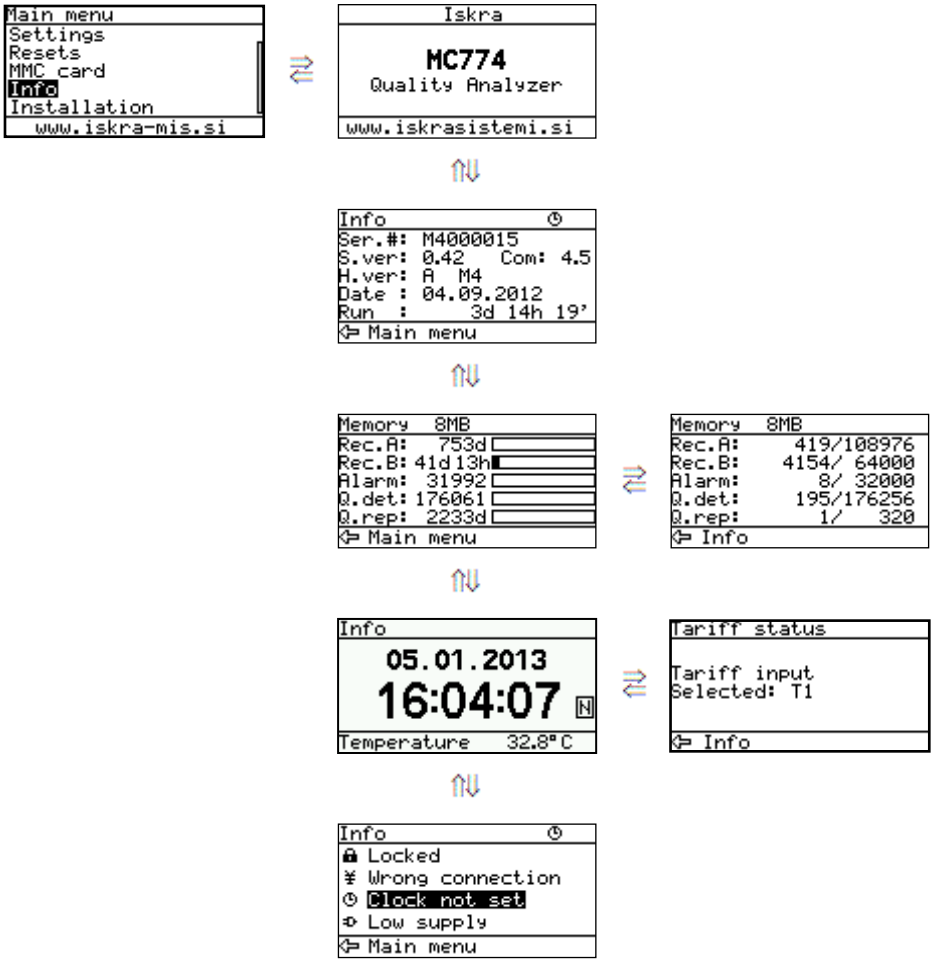
TCP Port

Set TCP communication Port. Default value is 10001. This setting is available only when Ethernet communication is built in.

Subnet mask

Set network subnet mask. Default value is 255.255.255.0. This setting is available only when Ethernet communication is built in.

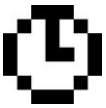
LCD Navigation



Notification icons

Navigation keys and LCD enable application and basic instrument settings. During the operation some icons can be displayed in upper part of LCD. The significance of icons (from right to left) is explained in the table below.

Icon	*Meaning*
	Device is locked with a password of the second level (L2). The first level (L1) can be unlocked.
	Device can be wrongly connected at 4u connection. Energy flow direction is different by phases.
	A built-in battery (for RTC) shall be replaced. A battery test is carried out at power supply connection (for devices with built in battery)
	The device supply is too low.



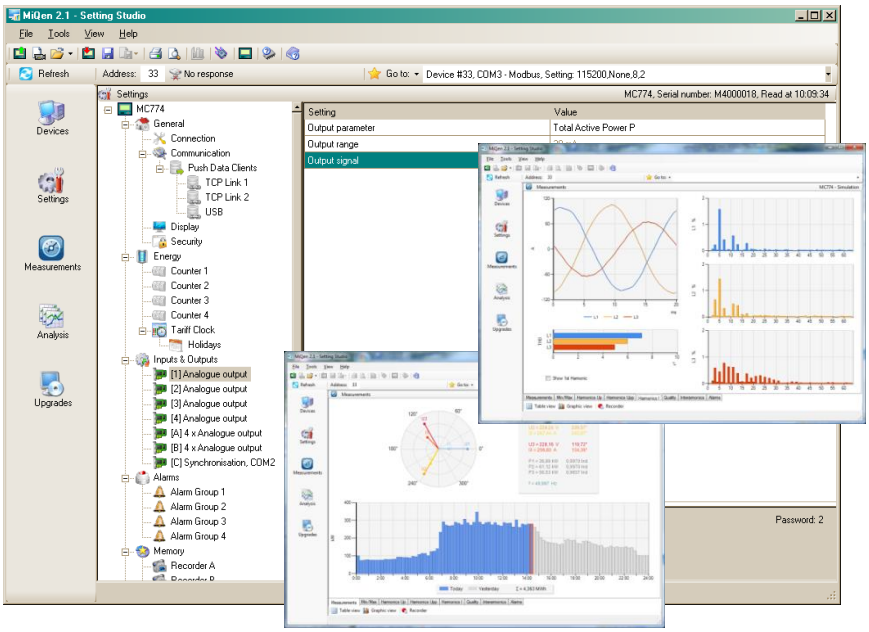
Clock not set
(for devices with built in super cap)
(when disconnected from aux. supply for more then 2 days)

SETTINGS

Settings of measuring centre can be performed via the front keypad and display or remotely using communication and MiQen software version 2.1 or higher. Setting is faster and easier by using MiQen. Basic and simpler settings are accessible via navigation keypad. For new setting to be activated settings file should be transferred to the device via communication (MiQen) or a memory card (where available). Setting done via navigation keypad comes in to function after confirmation (OK button) fallowed by a bit longer sound notification (beep).

MiQen software

MiQen software is a tool for a complete programming and monitoring of Iskra Sistemi measuring instruments. Remote operation is possible by means of serial (RS485/RS232), USB or TCP/IP communication in connection with a PC. A user-friendly interface consists of five segments: devices management, device settings, real-time measurements, data analysis and software upgrading. These segments are easily accessed by means of five icons on the left side (see Figure 2).



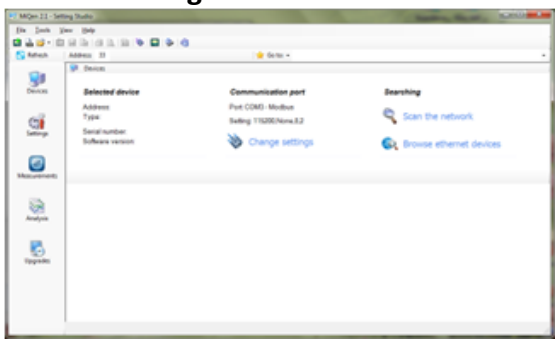
MiQen programming and monitoring software

MiQen version 2.0 or higher is required for programming and monitoring MC774Quality Analyser. Software installation is stored on a CD as a part of consignment or it can be downloaded from www.iskrasistemi.si.

PLEASE NOTE

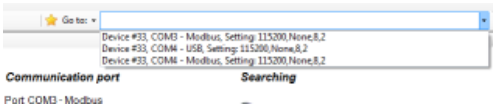
MiQen has very intuitive help system. All functions and settings are described in Info window on the bottom of MiQen window.

Devices management



MiQen Device Management window

With MiQen it is very easy to manage devices. If dealing with the same device that has been accessed before it can be easily selected from a favourite's line.


Device #33, COM3 - Modbus, Setting: 115200,None,8,2
Device #33, COM4 - USB, Setting: 115200,None,8,2
Device #33, COM4 - Modbus, Setting: 115200,None,8,2
Communication port
Searching
Port COM3 - Modbus

This way is Communication port set automatically as it was during last access.

To communicate with new device following steps should be fallowed:

Connect a device to a communication interface

-Depending on type of communication interface connect a device:

-Directly to a PC using RS232 cable

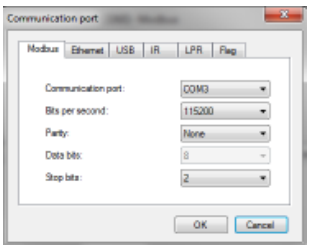
-To comm. adapter RS485 / RS232 (suggested adapter is ISKRA MI485)

-Directly to a PC using USB cable

-Network connection using Ethernet cable

Set Communication port parameters

Under Communication port current communication parameters are displayed. To change those parameters click on Change settings button. A Communication port window opens with different communication interfaces.



Choose correct communication interface (Modbus, Ethernet or USB) and set correct communication parameters.

PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver is provided on the CD, enclosed in the original shipment package, or it can be downloaded from the Iskra Sistemi d.d.

web page www.iskrasistemi.si. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen setting software.

For more information regarding parameters for serial, USB and Ethernet communication see chapters Serial Communication, USB communication and Ethernet communication.

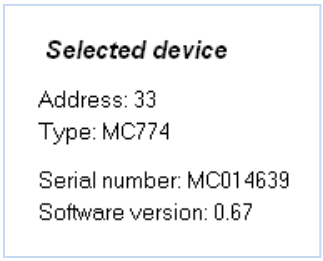
Set device Modbus address number

Each device connected to a network has its unique Modbus address number. In order co communicate with that device an appropriate address number should be set.

Factory default Modbus address for all devices is 33. Therefore it is required to change Modbus address number of devices if they are connected in the network so each device will have its unique address number.

Start communicating with a device

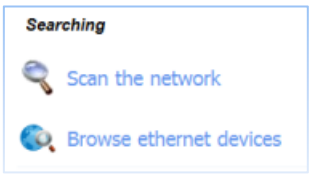
Click on REFRESH button and devices information will be displayed



When devices are connected to a network and a certain device is required it is possible to browse a network for devices. For this purpose choose

Scan the network when device is connected to a RS485 bus

Browse ethernet devices when device is connected to the Ethernet



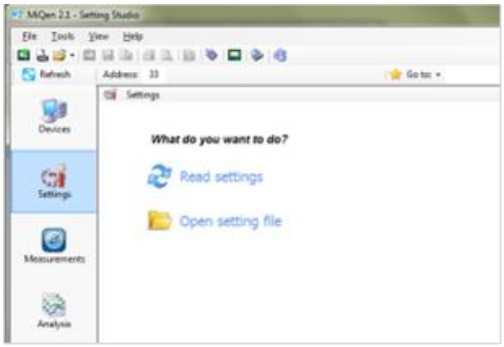
Device settings

Programming devices can be performed ONLINE when device is connected to aux. power supply and is communicating with MiQen. When device is not connected it is possible to adjust settings OFFLINE.

ONLINE programming

After communication with a device is established, choose icon *Settings* from a list of MiQen functions on a left side.

MiQen Device Setting window



Choose Read settings button to display all devices settings and begin adjusting them according to project requirement.

PLEASE NOTE

When finished programming, changes should be confirmed by pressing Download settings button in MiQen menu bar ( ) or with a mouse right click menu.

PLEASE NOTE

When finished programming, all settings can be saved in a setting file (*.msf file). This way it is possible to archive settings in combination with a date. It is also possible to use saved settings for offline programming or to programme other devices with same settings. For more information see OFFLINE programming.

OFFLINE programming

When device is not physically present or is unable to communicate it is still possible to perform OFFLINE programming. From MiQen Device Setting window (Figure 4) choose Open setting file button.

From a list of *.msf files choose either previously stored file (a setting file, which has been used for another MC774 and stored) or a file MC774.msf, which holds default settings for this device.

When confirmed all device settings are displayed similar as with ONLINE programming.

CAUTION

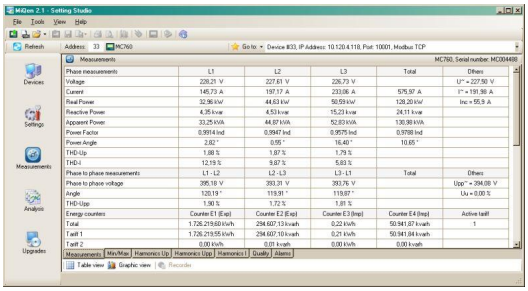
MXxxx.msf file or any other original device setting file should not be modified as it contains device default settings. Before adjusting settings according to project requirements save setting file under another name.

When finished programming, all settings can be saved in a setting file with a meaningful name (e.g. *MXxxx_location_date*.msf). This file can be then transferred to a Memory card and used for programming on filed devices, which are not accessible with communication.

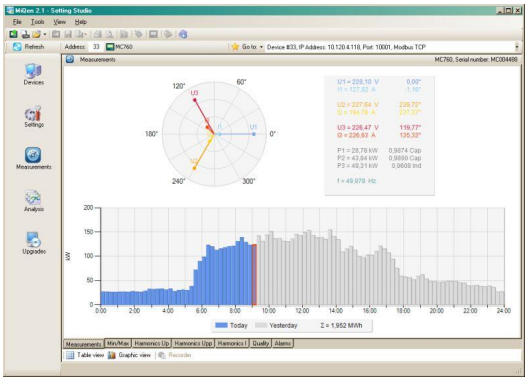
Real time measurements

Measurements can be seen ONLINE when device is connected to aux. power supply and is communicating with MiQen. When device is not connected it is possible to see OFFLINE measurements simulation.The latter is useful for presentations and visualisation of measurements without presence of actual device.

In ONLINE mode all supported measurements and alarms can be seen in real time in a tabelaric or graphical form.



Online measurements in tabelaric form



Online measurements in graphical form – phaser diagram and daily total active power consumption histogram

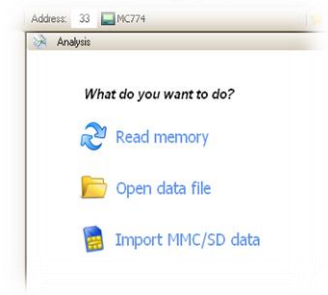
Different measuring data can be accessed by means of tabs (Measurements, Min/Max…) in the lower part of MiQen window.

For further processing of the results of measurements, it is possible to set a recorder (Recorder button) on active device that will record and save selected measurements to MS Excel .csv file format.

Window for setting local database recording parameters

Data analysis

In order to perform analysis data source has to be defined first. Data source can be one of the selected:



Read memory

Data is read directly from a devices internal memory

Open data file

Data is read from a local database

Import SD data

Data is imported from a SD memory card

Window for a choice of memory data to be analysed

After data is read or imported recorded quantities can be monitored in a tabular or a graphical form. The events that triggered alarms can be analyzed or a report on supply voltage quality can be made. All data can be exported to an Access data base, Excel worksheets or as a text file.

My Devices

Device upgrades

General Settings

General settings are essential for measuring Iinstruments. They are divided into four additional sublevels (Connection, Communication, Display and Security).

Description & Location

Description is intended for easier recognition of a certain unit in a network.

It is especially used for identification of the device on which measurements are performed.

Average interval

The averaging interval defines a refresh rate of measurements on display, communication. It is used also as averaging interval for minimum and maximum values stored in recorder and actual alarm value calculation for alarm triggering.

Interval can be set from 8 periods to 256 periods. Default value is 64 periods.

- Shorter average interval means better resolution in minimum and maximum value in to recorded period detection and faster alarm response. Also data presented in display will refresh faster.
- Longer average interval means lower minimum and maximum value in recorded period detection and slower alarm response (alarm response can be delayed also with Compare time delay setting – See chapter Alarms). Also data on display will refresh slower.

Average interval for measurements
The averaging interval defines a refresh rate of measurements on display, communication and analogue outputs. It also defines response time for alarms set to Normal response (see chapter Alarms).

-Shorter average interval means better resolution in minimum and maximum value in to recorded period detection and faster alarm response. Also data presented in display will refresh faster.

-Longer average interval means lower minimum and maximum value in recorded period detection and slower alarm response (alarm response can be delayed also with Compare time delay setting – See chapter Alarms). Also data on display will refresh slower.

Interval can be set from 0.1 to 5 s. Default value is 1 s.

Average interval for Min/Max values
The averaging interval for Min/Max values defines an interval on which values will be averaged to track Min and Max values. By choosing shorter interval also very fast changes in the network will be detected. Interval can be set form 1 to 256 periods.

PLEASE NOTE

This setting applies only for min. and max. values displayed on LCD and accessible on communication. These values are not used for storing into internal recorder. For more information about recording min. and max. values see Min and Max values.

Language
Set language for display. When language is changed from or to Russian, characters of the password are changed too. For overview of character translation.

PLEASE NOTE

If a wrong language is set, a menu of languages is displayed by simultaneous pressing up and down keys.

Currency
Choose currency for evaluating energy cost. A currency designation consists of up to four letters taken from the English or Russian alphabet and numbers and symbols stated in table below.

English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Symbols		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0 to 9			:	;	<	=	>	?	@
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ
	а	б	в	г	д	е	ж	з	и	й	к	Л	м	н	о	п	р	с	т	у	ф	х	ц	ч	ш	щ

Temperature unit
Choose a unit for temperature display. Degrees Celsius or degrees Fahrenheit are available.

Date format
Set a date format for time stamped values.

Date and time
Set date and time of the device. Setting is important for correct memory operation, maximal values (MD), etc. If instrument is connected to one of supported time synchronisation sources, date and time are automatically set.

Real Time Synchronisation Source
Synchronized real-time clock (RTC) is an essential part of any Class A analyzer for proper chronological determination of various events. To distinct cause from consequence, to follow a certain event from its origin to manifestation in other parameters it is very important that each and every event and recorded measurement on one device can be compared with events and measurements on other devices. Even if devices are dislocated, which is normally the case in electro distribution network events have to be time-comparable with accuracy better than a single period.

For this purpose devices normally support highly accurate internal RTC. Still this is not enough, since temperature is location dependant and it influences its precision. For that reason it is required to implement periodical RTC synchronization.

CAUTION

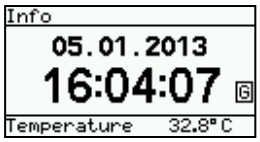
RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

This setting is used to choose primary synchronisation source.

- NO synchronisation (not advisable, see CAUTION above)
- NTP synchronisation
- MODULE C synchronisation

Synchronisation status can be checked on display when set to INFO display.

Notification icon N shows successful NTP synchronisation



Notification icon G shows successful GPS synchronisation. If only 1pps signal is present (without date and time feed) notification icon G is present

Notification icon I shows successful IRIG synchronisation

Auto Summer/Winter time

If *Yes* is chosen, time will be automatically shifted to a winter or a summer time, regarding the time that is momentarily set.

Maximum demand calculation (MD mode)

The device provides maximum demand values from a variety of average demand values:

-Thermal function

-Fixed window

-Sliding windows (up to 15)

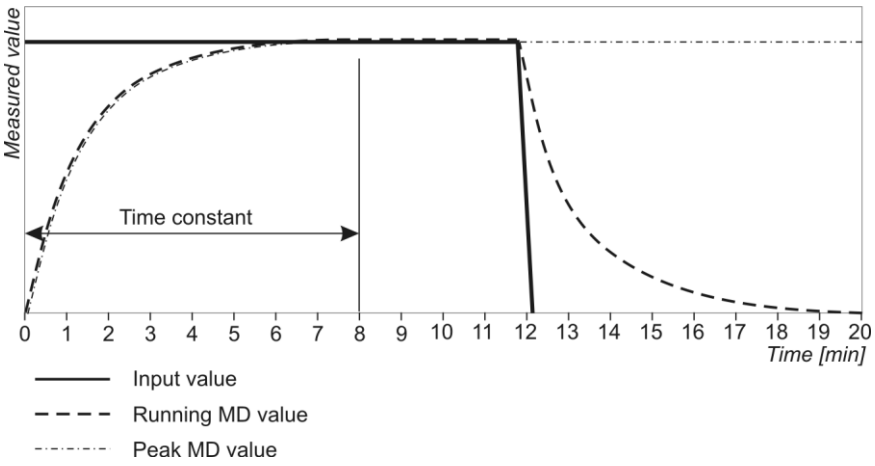
Thermal function

A thermal function assures exponent thermal characteristic based on simulation of bimetal meters.

Maximal values and time of their occurrence are stored in device. A time constant can be set from 1 to 255 minutes and is 6 times thermal time constant (t. c. = 6 × thermal time constant).

Example:

Mode:	Thermal function
Time constant:	8 min.
Running MD and maximal MD:	Reset at 0 min.



Operation of thermal MD function

Fixed window

A fixed window is a mode that calculates average value over a fixed time period. Time constant can be set from 1 to 255 min.

»Time into period« as displayed in MiQen – help tip actively shows the remaining time until the end of the period in which current MD and maximal MD from the last reset are calculated.

When displays for Pt(+/−), Qt(L/C), St, I1, I2 and I3 are updated, a new period and measurement of new average values are started. »TIME INTO PERIOD« then shows 0 of X min where X is Time Constant.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME INTO PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME INTO PERIOD« is set to 0.

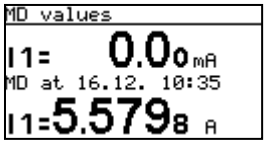
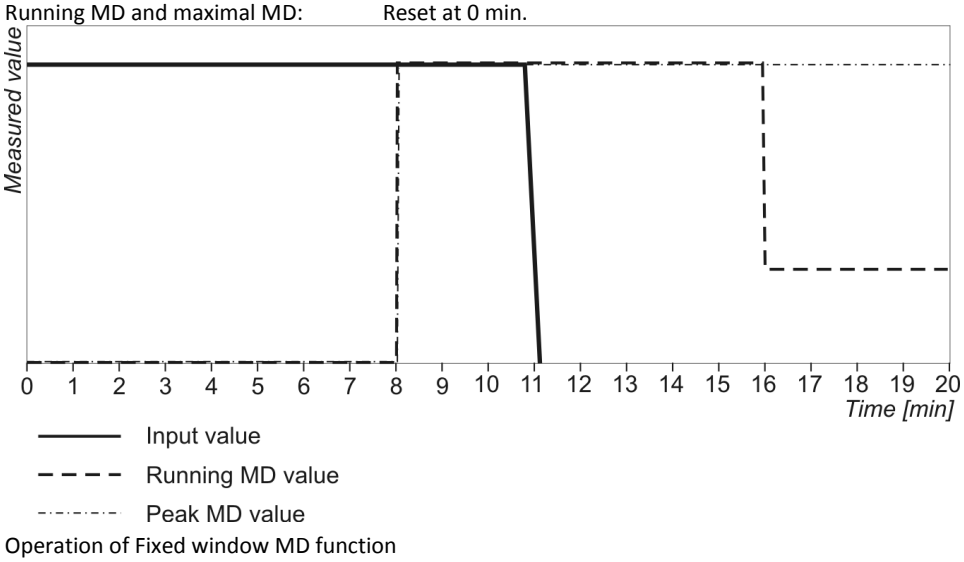


Figure above shows display of MD measurement for current I1. Running MD is displayed (0 mA), max. value of MD since last reset is displayed and its time of occurrence.

Example:

Mode:	Fixed window
Time constant:	8 min.
Running MD and maximal MD:	Reset at 0 min.



Operation of Fixed window MD function

A mode of sliding windows enables multiple calculations of average in a period and thus more frequent refreshing of measuring results. Average value over a complete period is displayed. A running MD is updated every sub-period for average of previous sub-periods.

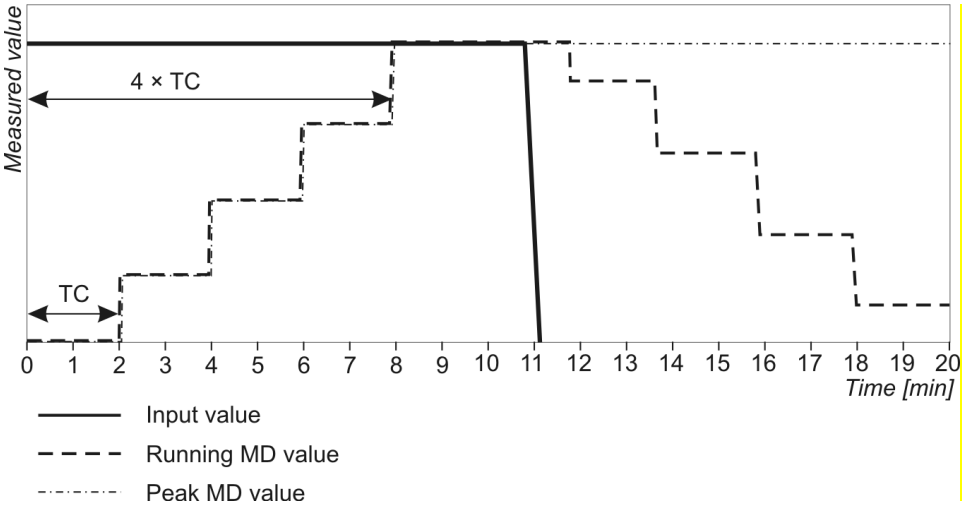
A number of sub-periods can be set from 2 to 15.
A time constant can be set from 1 to 255 minutes.

A new period also starts after a longer interruption of power supply (more than 1 s). If time constant is set to one of the values of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, »TIME INTO PERIOD« is set to such value that one of the following intervals will be terminated at a full hour. In other cases of time constants, »TIME INTO PERIOD« is set to 0.

Example:

Mode:	Sliding windows
Time constant:	2 min.
No. of sub-periods:	4
Running MD and maximal MD:	Reset at 0 min.

A complete period lasts for 8 minutes and consists of 4 sub-periods that are 2 minutes long. A running MD and a maximal MD are reset at 0 min. "Time into period" is data for a sub period so that the values for a running MD and a maximal MD are refreshed every two minutes. After 4 sub-periods (1 complete period) the oldest sub period is eliminated when a new one is added, so that average (a window) always covers the last 4 sub-periods.



Operation of Sliding window MD function

MD Time constant (min)
The instrument provides maximum demand values based on a thermal function. Thermal function time constant can be selected via keyboard or via communication.

+

Thermal function

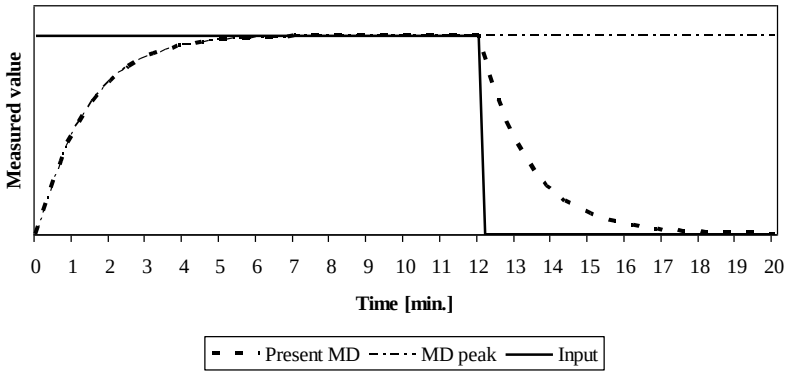
A thermal function assures exponent thermal characteristic based on simulation of bimetal meters.

Maximal values and time of their occurrence are stored in device. A time constant (t. c.) can be set from 1 to 255 minutes and is 6 − time thermal time constant (t. c. = 6 * thermal time constant).

Example:

Mode: Thermal function
Time constant: 8 min.
Current MD and maximal MD: Reset at 0 min.

Thermal function



Maximum demand reset mode

This setting defines a mode of resetting Max demand values. It can be set to:

Manual: User resets max demand value with keypad or setting software (see chapter Reset)

Automatic:

- Daily: every day at 00:00,
- Weekly: on Monday at 00:00,
- Monthly: the first day in a month at 00:00,
- Yearly: the first day in a year 1.1. at 00:00

Min/Max reset mode

This setting defines a mode of resetting stored Min/Max values. It can be set to.

Manual: User resets min/max values with keypad or setting software (see chapter *Reset*).

Automatic:

- Daily: every day at 00:00,
- Weekly: on Monday at 00:00,
- Monthly: the first day in a month at 00:00,
- Yearly: the first day in a year 1.1. at 00:00

Starting current for PF and PA (mA)

All measuring inputs are influenced by noise of various frequencies. It is more or less constant and its influence to the accuracy is increased by decreasing measuring signals. It is present also when measuring signals are not present or are very low. It causes very sporadic measurements.

This setting defines the lowest current that allows regular calculation of Power Factor (PF) and Power Angle (PA).

The value for starting current should be set according to conditions in a system (level of noise, random current fluctuation …)

Starting current for all powers (mA)

Noise is limited with a starting current also at measurements and calculations of powers. The value for starting current should be set according to conditions in a system (level of noise, random current fluctuation …)

Starting voltage for SYNC

Device needs to synchronize its sampling with measuring signals period to accurately determine its frequency. For that purpose, input signal has to large enough to be distinguished from a noise.

If all phase voltages are smaller than this (noise limit) setting, instrument uses current inputs for synchronization. If also all phase currents are smaller than Starting current for PF and PA setting, synchronization is not possible and frequency displayed is 0.

The value for starting voltage should be set according to conditions in a system (level of noise, random voltage fluctuation …)

Harmonics calculation

Relative harmonic values can be different according to used base unit. According to requirements relative harmonics can be calculated as:

- percentage of RMS signal value (current, voltage) or
- percentage of the fundamental (first harmonic).

Reactive power & energy calculation

Harmonic distortion can significantly influence reactive power and energy calculation. In absence of harmonic distortion both described methods will offer the same result. In reality harmonics are always present. Therefore it is up to project requirements, which method is applicable.

User can select between two different principles of reactive power and energy calculation:

Standard method:

With this method a reactive power and energy are calculated based on assumption that all power (energy), which is not active, is reactive.

$Q2 = S2 – P2$

This means also that all higher harmonics (out of phase with base harmonic) will be measured as reactive power (energy).

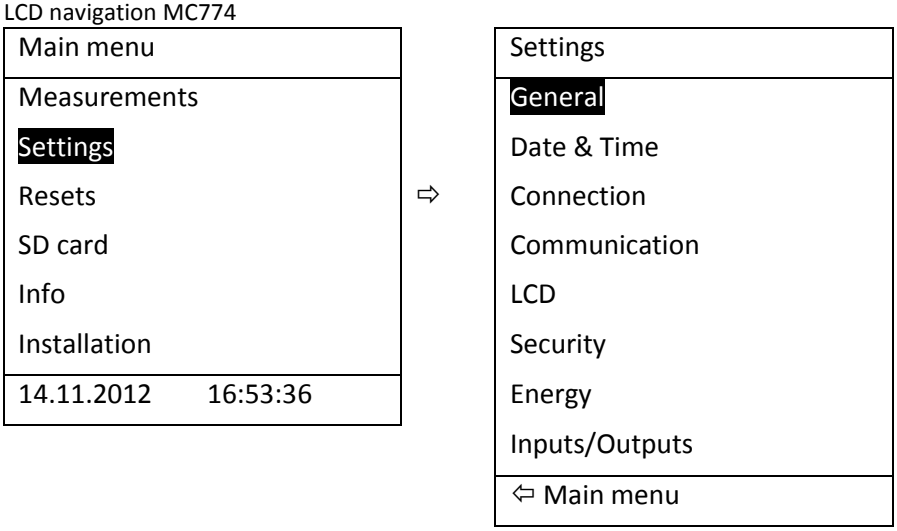
Displacement method:

With this method, reactive power (energy) is calculated by multiplication of voltage samples and by 90° displaced current samples.

$Q = U \times I|_{+90°}$

With this method, reactive power (energy) represents only true reactive component of apparent power (energy).

LCD navigation MC774



Average interval:

OK Main menu > Settings > General > Average interval

Language:

OK Main menu > Settings > General > Language

Currency:

OK Main menu > Settings > General > Currency

Temperture unit:

OK Main menu > Settings > General > Temperature unit

Date format:

OK Main menu > Settings > Date & Time > Date format

Date and time:

OK Main menu > Settings > Date & Time > Date / Time

Auto Summer/Winter time:

Main menu > Settings > Date & Time > Automatic S/W time

Maximum demand calculation (MD mode):

Main menu > Settings > General > MD mode / MD time const.

MD time constant (min):

Main menu > Settings > General > MD time constant

Min/Max reset mode:

Main menu > Settings > General > Min/Max reset mode

Connection

CAUTION

Settings of connections shall reflect actual state otherwise measurements could not be valid.

Connection mode

When connection is selected, load connection and the supported measurements are defined.

Setting of current and voltage ratios

Before setting current and voltage ratios it is necessary to be familiar with the conditions in which device will be used. All other measurements and calculations depend on these settings. Up to five decimal places can be set (up / down). To set decimal point and prefix (up / down) position the cursor (left /right) to last (empty) place or the decimal point.

Aux CT transformer ratios can be set separately from phase CT ratios since Aux CT could differ from phase CTs.

Range of CT and VT ratios:

Settings range	*VT primary*	*VT secondary*	*CT, Aux CT primary*	*CT, Aux CT secondary*
Max value	1638,3 kV	13383 V	1638,3 kA	13383 A
Min value	0,1 V	1 mV	0,1 A	1 mA

Neutral line Primary/Secondary current (A)

Primary /Secondary current of neutral line current transformer.

Used voltage/current range (V/A)

Setting of the range is connected with all settings of alarms, analogue outputs and a display (calculation) of energy and measurements recording, where 100% represents 500 V. In case of subsequent change of the range, alarms settings shall be correspondingly changed, as well.

CAUTION

In case of subsequent change of those ranges shall be alarm and analogue output settings correspondingly changed as well.

Already recorded values will not be valid after change of used voltage and current range!

Frequency nominal value (Hz)

Nominal frequency range can be selected from a set of predefined values. A valid frequency measurement is within the range of nominal frequency ±32 Hz.

This setting is used for alarms and recorders only.

Max. demand current for TDD (A)

Select maximum current (CT or fuse rating) at a point of instrument connection for proper TDD calculation. TDD is unlike THD a measure of harmonics relative to fixed value of max. demand current. Therefore TDD is a demand independent measure of current harmonics.

Wrong connection warning

If all phase currents (active powers) do not have same sign (some are positive and some negative) and/or if phase voltages and phase currents are mixed, the warning will be activated if this setting is set to YES. This warning is seen only on remote display.

Energy flow direction

This setting allows manual change of energy flow direction (IMPORT to EXPORT or vice versa) in readings tab. It has no influence on readings sent to communication or to memory.

CT connection

If this setting is set to REVERSED it has the same influence as if CT's would be reversely connected. All power readings will also change its sign.

This setting is useful to correct wrong CT connections.

LCD navigation MC774

Main menu	
Measurements	
Settings	
Resets	
SD card	
Info	
Installation	
14.11.2012	16:53:36

⇨

Settings
General
Date & Time
Connection
Communication
LCD
Security
Energy
Inputs/Outputs
⇦ Main menu

Connection mode:

OK Main menu > Settings > Connection > Connection mode

Setting of current and voltage ratios:

OK Main menu > Settings > Connection > VT primary/VT secondary/CT primary/CT secondary

Communication

Communication parameters (COM 1)

They define parameters that are important for the operation in RS485 network or connections with PC via RS232 communication. Factory settings of communication are #33\115200,n,8,2 (address 1 to 247\rate 2400 to 115200 b/s, parity, data bits, stop bit).

Serial communication

Communication parameters (only for main communication port COM1), which are important for the operation in RS485 network or connections with PC via RS232 communication.

Factory settings for serial communication are:

MODBUS Address	#33	address range is 1 to 247
Comm. speed	115200	speed range is 2400 to 115200
Parity	none	
data bits	8	
stop bits	2	

PLEASE NOTE

Additional settings referring to secondary communication port COM2 via synchronisation module C (in MiQen software) can be found in chapter RTC Synchronisation Module C, COM2.

Modbus table for measurements

Modbus table (MI400 or MT500 compatible): With this setting a MODBUS table for measurements and settings is defined. MODBUS addresses for measurements and settings can be compatible with previous family of transducers (MI400) or with more advanced family of transducers (MT500). See Modbus table definitions.

Push Data Format

With this setting a required data format for sending data to receiver using PUSH communication mode is set. Currently supported format is XML-smart. For more information about PUSH communication mode and XML data format see chapter Communication modes and appendix D.

Push Response Time (sec)

With this setting a maximum waiting time for acknowledgement of sent data in PUSH communication mode is set. If acknowledgement from a client is not sent within this time, scheduled data will be resend in next push period.

* Setting comes in to consideration only if device is connected to MiSmart system via serial communication.

(Push) Time Synchronisation

In case where no other synchronisation source is available (GPS, IRIG-B, NTP), RTC can be synchronised by push data client. This type of synchronisation strongly depends on communication infrastructure and it is not as accurate as required by IEC 61000-4-30. It has the lowest priority and cannot override RTC synchronised by any of other sources.

Time synchronization

* Which type of communication is used for synchronization of time for PUSH communication mode purpose.

* Setting comes in to consideration only if device is connected to MiSmart system via serial communication.

USB Communication

There is no special setting for USB communication. For more detailed information how to handle device with USB communication use Help section in MiQen software.

PLEASE NOTE

Device supports only a single communication input (USB or Ethernet) at a time when using primary communication port COM1. Priority has USB communication. If communication using ethernet is in progress, do not connect to USB since it will terminate ethernet connection. When USB cable is unplugged from the device ethernet communication is again available.

PLEASE NOTE

When device is connected to a PC through USB communication for the first time, a user is prompted to install a driver. The driver is provided on the CD, enclosed in the original shipment package, or it can be downloaded from the Iskra Sistemi d.d. web page www.iskrasistemi.si. With this driver installed, USB is redirected to a serial port, which should be selected when using MiQen setting software.

Service USB Communication

Has no setting. Device is automatically recognized in Windows environment if device driver has been correctly installed. For more detailed information how to handle device with USB communication use Help section in MiQen software.

PLEASE NOTE

Service USB is intended only for parameterisation of the meter and is not galvanic separated. Advantage is that in this case meter does not need a power supply to communicate. Communication via service port is time limited.

PLEASE NOTE

Service USB communication is not galvanic separated!

When using service USB communication, power supply and measuring voltages need to be disconnected!

Enthernet communication

Ethernet communication is used for connection of device to the Ethernet network for remote operation. Each device has its own MAC address that at some cases needs to be provided and is printed on the label on the device.

Device Address

Device Address: Device address is important when user is trying to connect to device via MiQen software. Usable range of addresses is from 1 to 247. Default address number is 33. (Not important when Ethernet communication is used.)

IP Address

Communication interface should have a unique IP address in the Ethernet network. Two modes for assigning IP are possible:

Fixed IP address:

In most installations a fixed IP address is required. A system provider usually defines IP addresses. An IP address should be within a valid IP range, unique for your network and in the same subnetwork as your PC.

DHCP:

Automatic (dynamic) method of assigning IP addressed (DHCP) is used in most networks. If you are not sure if DHPC is used in your network, check it at your system provider.

IP Hostname

It is the nickname that is given to a device. Hostnames may be simple names consisting of a single word or phase or they may be structured. The setting is used in automatic (DHCP) mode only.

Local port

When using Ethernet communication device has opened two local ports.

-Fixed port number 502, which is a standard MODBUS port. Device allows multiple connections to this port.

-User defined port. Any port number is allowed except reserved ports (*Table 7*). Only a single connection is allowed to this port. When this port is used all other connections (including connection to port 502) are disabled. This is a terminal type of connection.

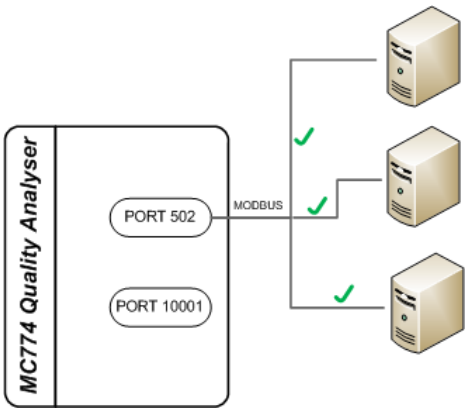
Terminal type of connection is used when due to a performed function other connections are not allowed. This is the case when firmware update is performed. In other cases it is advised to use port 502.

When port 502 is used a remote application(s) can access device regardless the setting for *Local Port* in a device. This setting is applicable only when terminal access is required.

Reserved TCP Port numbers

Important port numbers	Function

1 – 1024, 9999, 30718, 33333	Reserved numbers!!!
502	Standard MODBUS port – fixed
33333	UDP port used for Device Discovery Service



Multiple connections to a device are possible when port 502 (special MODBUS port) is used

Port 502

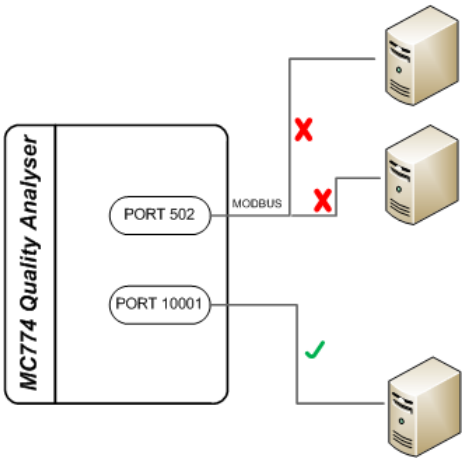
Is standardized port to communicate with the device via MODBUS/TCP communication protocol and is fixed. Communication via this port allows multiple connections to the device. Communication over this port does not block any other traffic.

Port 33333

This UDP port is reserved for Discovery Service, a service run by MiQen software, to discover devices connected in to local Ethernet communication network.

Other available Ports

Other, allowed TCP ports, are acting as terminal port and when connected to it, it blocks all other connections until it is released.
Priority, when connected to this port, has PUSH functionality of the device.



When any other allowed port is used only a single connection is possible

Subnet Mask
It is used to determine what subnet an IP address belongs to.

Gateway Address
It is a gateway that connects separate network segments (LAN, WAN or internet).

NTP Server
IP address of a NTP server used for time synchronisation of the device.

NTP can usually maintain time to within tens of milliseconds over the public Internet, but the accuracy depends on infrastructure properties - asymmetry in outgoing and incoming communication delay affects systematic bias.

PLEASE NOTE

It is recommended that dedicated network rather than public network is used for synchronisation purposes.

Factory settings of Ethernet communication are:

IP Address	DHCP (automatically)
TCP Port (Terminal Port)	10001
Subnet Mask	255.255.255.0

Push communication settings
When PUSH communication mode is used, data can be sent (pushed) to two different servers. Within this setting, all parameters relevant to used servers should be set, as well as data type for sent data, time synchronization source and server response time.

For more information about PUSH communication mode and XML Data format see chapter *Communication modes.*

TCP Link 1 and TCP Link 2 (Push data clients)
- IP address
- IP address of the server collecting data from devices.
- IP port
- IP port of the serve collecting data from devices.
- Data Format

With this setting a required data format for sending data to receiver using PUSH communication mode is set. Currently supported format is XML-smart. For more information about PUSH communication mode and XML data format see Communication modes on page and appendix D.

Response Time (sec)

With this setting a maximum waiting time for acknowledgement of sent data in PUSH communication mode is set. If acknowledgement from a client is not sent within this time, scheduled data will be resend in next push period.

For devices connected in communication network with slow communication speed, values over 10 seconds needs to be selected.

If value lower than 10 second is selected, historical data from recorders are pushed immediately one after another. If value is higher than 10 seconds, automatic time delay length of 10% of set value is integrated between the sent packets.

MAC Address
Read only information about device MAC address.

Firmware version

Read only information about communication module firmware version.

Sending data

When PUSH communication mode is used, data can be send (pushed) to two different servers. Within this setting, all parameters relevant to used servers should be set, as well as data type for sent data, time synchronization source and server response time.

For more information about PUSH communication mode and XML data format and appendix D .

Communication modes

MC774 Quality Analyser supports two communication modes to suit all demands about connectivity and flexibility.

Standard POLL communication mode is used for most user interaction purposes in combination with monitoring and setting software MiQen, SCADA systems and other MODBUS oriented data acquisition software.

PUSH communication mode is used for sending unsolicited data to predefined links for storing data do various data bases.

POLL communication mode

This is most commonly used communication mode. It services data-on-demand and is therefore suitable for direct connection of setting and / or supervising software to a single device or for a network connection of multiple devices, which requires setting up an appropriate communication infrastructure.

Data is sent from device when it is asked by external software according to MODBUS RTU or MODBUS TCP protocol.

This type of communication is normally used for a real-time on-demand measurement collection for control purposes.

To set up PULL communication mode, only basic communication settings are required according to communication type (serial, USB, ETHERNET).

PUSH communication mode

PUSH communication mode is mainly used for Iskra Sistemi *MiSmart* system for remote monitoring, analysis and reporting.

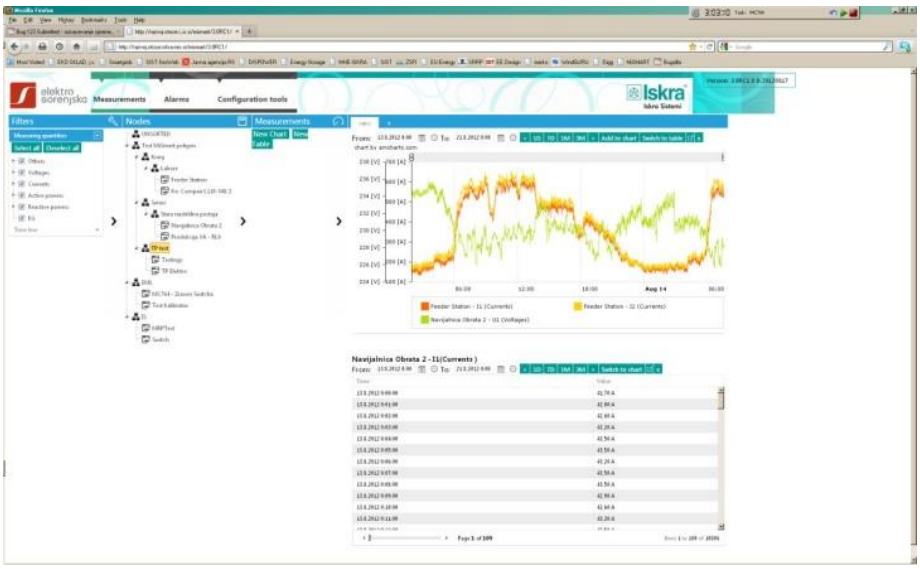
The most extensive benefits when using *MC774 Quality Analyser* are achieved when device is used as a part of an energy monitoring system comprising of strategically positioned meters connected to *MiSMART* software solution. This three-tier middleware software represents a perfect tool for utility companies, energy suppliers and other parties present on both ends of supply-demand chain.

MiSMART data collector with “push” communication system allows automatic records of all predefined measuring parameters. They are stored in

MiSMART database, while leaving a copy of same parameters stored locally in memory of each device as a backup copy. Database records in XML format can be searched and viewed in tabelaric and graphical form using

MiSMART client or used by third-party application software.

Database records can involve numerous parameters of three-phase system, power quality parameters, physical parameters (temp., pressure, wind speed…) as well as alarms and event logs.



MiSMART client window

Explanation

When in this communication mode, device (master) is sending values of predefined quantities in predefined time intervals to two independent servers (data collectors - slave), who collect data into data base for further analysis.

This mode of communication is very useful for a periodic monitoring of readings in systems where real-time data are not required, but on the other side, reliability for collecting data is essential (e.g. for billing purposes, post processing and issuing trend warnings).

On the other hand, when operating in this mode, the device will send information about alarms immediately as they occur (real time alarm monitoring).

This type of communication also optimizes communication traffic.

Protocol and data format

Device uses XML format to send the data, which is very common and easy to use also for third party software solutions. Protocol used for data transmission is TCP/IP.

All sent readings are time-stamped for accurate reconstruction of received data (if communication is lost and data is sent afterwards). Therefore time synchronization of client and server is essential. For that purpose, server sends synchronization data packet to the device within every response to received data. If time difference is higher than +/- 2s, device resets its internal clock. For more information about used XML format see Appendix D.

CAUTION

Time synchronisation with push system has the lowest priority. If any of other time synchronisation sources is available (GPS, NTP, IRIG-B) they have priority to synchronise RTC.

By using time synchronisation with push functionality device does not meet requirements for Class A

measuring device and can be used only as a Class S measuring device.

Data transmission

Every transmission from master side (device) must be acknowledged from client side (server) to verify successful data transmission. In case client fails to receive acknowledgment after predefined response time (see *Ethernet communication on page* **Napaka! Zaznamek ni definiran.**) it will retry to send it in next time interval. This repeating of sending data will last until master responses to sent data. After that, client will send all available data from the moment it lost response from the master.

It is possible for PULL and PUSH communication mode to be active at the same time. Both communication modes can be handled at the same time if PULL communication is made over COM2 or over Ethernet module through port reserved for

communication over MODBUS communication protocol (port 502 see chapter *Ethernet communication on page* **Napaka! Zaznamek ni definiran.**).

Supported quantities and settings

Sending data in PUSH communication mode is closely related with storing measurements in a recorder. Device can sent to the selected server(s) a block of measure quantities that are stored in memory. For each memory division (recorders A to D, alarms recorder and quality reports with details recorder) separate settings can be made.

Step 1

With MiQen software set proper PUSH Communication settings where time synchronization source, response time, data format and receiving server's parameters are defined.

Step 2

Define data (quantities) for recorder / transmission. For each part of the recorder select to which of the server(s) data will data be sent. This setting can be made for Alarms, Recorder A to D, Quality reports and details.

More information about PUSH data transfer and MiSmart system for collecting of this data can be found on ISKRA web page or in documentation about MiSmart system.

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Communication parameters (COM 1):

OK Main menu > Settings > Communication

Serial communication:

OK Main menu > Settings > Communication

Enthernet communication:

OK Main menu > Settings > Communication > (all settings are not supported on keypad)

Display

Display settings: Contrast/Black light intersity

A combination of setting of the contrast and back light defines visibility and legibility of a display. Display settings shall be defined in compliance with the conditions in which it will be monitored. Economizing mode switches off back light according to the set time of inactivity.

Saving mode (min)

Defines the time in minutes for the instrument to get into energy saving mode (backlight off). Enter value 0 if you don't want to use energy saving mode.

Demo cycling period (sec)

For demonstration purposes it is useful for device to automatically switch between different displays of measurements.

This setting defines time in seconds for each displayed screen of measurements.

Custom screen 1/2/3

For easier and faster survey of measurements that are important for the user, three settings of customized screens are available. Each customized screen displays three measurements. When setting customized screens the designations are displayed in shorter form, with up to 4 characters. For survey of all designations see chapter Survey of supported measurements regarding connectio.

Example:

Desired result:

Customized screen 1	*Customized screen 2*	*Customized screen 3*	*Combined customized screen 4*
U1	I_{TOT}	$\varphi_{1\text{-}3\_RMS}$	U1
$U_{P\text{-}P\_avg}$	I_{NM}	f	$U_{P\text{-}P\_avg}$
$U_{UNBALANCE}$	I_{AVG}	THD-I1	$U_{UNBALANCE}$
-	-	-	I_{TOT}
-	-	-	I_{NM}

PLEASE NOTE

Customized screens defined here are selected in menu.

OK Main menu > Measurements > Present values > Custom

Setting can be made only for 3 customized screens. 4th customized screen is showing 5 parameters, three from Customized screen 1 and first two from Customized screen 2. See example above.

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Display settings:

OK Main menu > Settings > LCD > Contrast / Back light / Back light time off

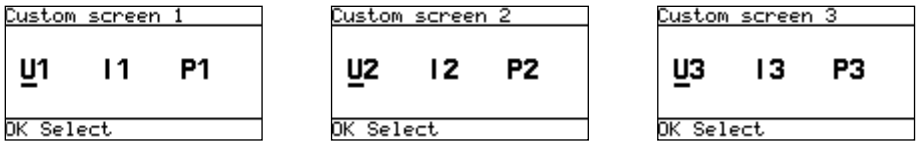
Demo cycling period (sec):

OK Main menu > Settings > LCD > Demo cycling period

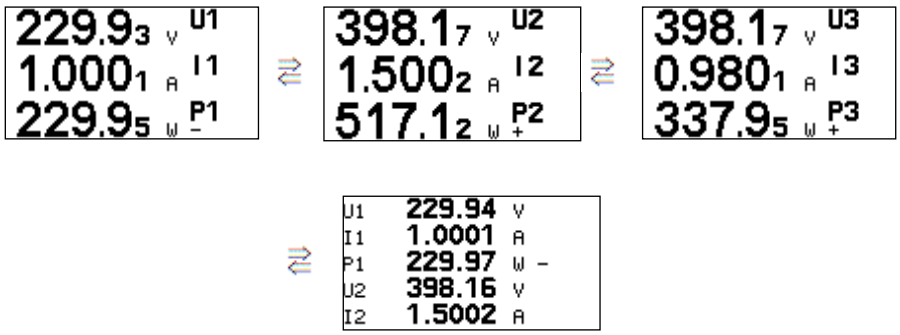
Custom screen:

OK Main menu > Settings > LCD > Custom screen 1 / 2 / 3 / (4)

Customized screen 1 Customized screen 2 Customized screen 3



Main menu > Measurements > Present values > Custom



Security

Settings parameters are devided into four groups regarding security level: PL0 >password level 0), PL1 >password level 1), PL2 >password level 2) and BP >a backup password).

PLEASE NOTE

A serial number of device is stated on the label and is also accessible with MiQen software.

Password-Level 0 >PL0)

Password is not required.

Available settings:

- language
- contrast and
- LCD back light.

Password-Level 1 >PL1)

Password for first level is required.

Available settings:

- RTC settings
- Energy meters reset
- Max. Demand reset
- Active tariff setting

Password-Level 2 >PL2)

Password for second level is required.

Available settings:

- All settings are available

A Backup Password->BP)

A backup password >BP) is used if passwords at levels 1 >PL1) and 2 >PL2) have been forgotten, and it is different for each device >depending on a serial number of the device). The BP password is available in the user support department in ISKRA SISTEMI d.d., and is entered instead of the password PL1 or/and PL2. Do not forget to state the device serial number when contacting the personnel in ISKRA SISTEMI d.d.

Password locks time >min)

Defines the time in minutes for the instrument to activate password protection. Enter value 0 if you want to use manual password activation.

Password setting

A password consists of four letters taken from the British alphabet from A to Z. When setting a password, only the letter being set is visible while others are hidden.

A password of the first >PL1) and the second >PL2) level is entered, and time of automatic activation is set.

Password modification

A password is optionally modified; however, only that password can be modified to which the access is unlocked at the moment.

Password disabling

A password is disabled by setting the "AAAA" password.

PLEASE NOTE

A factory set password is "AAAA" at both access levels >L1 and L2). This password does not limit access.

Password and language

Language change is possible without password input. When language is changed from or to Russian, character transformation has to be taken in to account. Character transformation table >English or Russian alphabet) is stated below.

English	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Russian	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	

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The access to the device serial number via a keyboard.

Example:

OK Main menu > Info

Password Level 1:

Main menu > Settings > Security > Password level 1

Password Level 2:

Main menu > Settings > Security > Password level 2

Password locks time >min):

Main menu > Settings > Security > Password lock time

Password setting:

Main menu > Settings > Security > Password level 1 / Password level 2 / Password lock time

Password modification:

Main menu > Settings > Security > Password level 1 / Password level 2

Password disabling:

Main menu > Settings > Security > Password level 1 / Password level 2 > "AAAA" O

Energy

WARNING!

Before modification, all energy counters should be read or if energy values are stored in recorders, recorder should be read with MiQen software to assure data consistency for the past.

After modification of energy parameters, the energy meters (counters) should be reset. All recorded measurements from this point back might have wrong values so they should not be transferred to any system for data acquisition and analysis. Data stored before modification should be used for this purpose.

Active Tariff

When active tariff is set, one of the tariffs is defined as active; switching between tariffs is done either with a tariff clock or a tariff input. For the operation of the tariff clock other parameters of the tariff clock that are accessible only via communication must be set correctly.

Common Energy Counter Resolution

Common energy exponent defines minimal energy that can be displayed on the energy counter. On the basis of this and a counter divider, a basic calculation prefix for energy is defined (−3 is 10−3Wh = mWh, 4 is 104Wh = 10 kWh). A common energy exponent also influences in setting a number of impulses for energy of pulse output or alarm output functioning as an energy meter.

Define common energy exponent as recommended in table below, where counter divider is at default value 10. Values of primary voltage and current determine proper Common energy exponent.

Current / *Voltage*	1 A	5 A	50 A	100 A	1000 A
110 V	100 mWh	1 Wh	10 Wh	10 Wh	100 Wh
230 V	1 Wh	1 Wh	10 Wh	100 Wh	1 kWh
1000 V	1 Wh	10 Wh	100 Wh	1 kWh	10 kWh
30 kV	100 Wh	100 Wh	1 kWh	10 kWh	10 kWh *

* – Individual counter resolution should be at least 100.

Common Energy Cost Exponent

Setting enables resolving the cost display. On the basis of this and a counter divider constant, a basic calculation prefix for energy cost is defined.

Counter divider

The counter divider additionally defines precision of a certain counter, according to settings of common energy exponent.

An example for 12.345kWh of consumed active energy:

Common energy exponent	0	2	2
Counter divider	1	1	100
Example of result, displayed	12.345 kWh	12.3 kWh	0.01 MWh

Common Tariff Price Exponent

Exponent and price represent energy price (active, reactive, common) in a tariff. The tariff price exponent is used for recording the price without decimal places. For example, to set a price for tariff 1 to 0,1567 €/kWh, the number in Price for energy in tariff 1 field should be 1567 and Common tariff price exponent should be -4 (1567 x 1E-4 = 0,1567)

An example for 12.345kWh of consumed active energy in the first tariff (price 0,1567 €/kWh):

Common Energy Counter Resolution	1 Wh	100 Wh	100 Wh
Individual Energy Counter Resolution	1	1	100
Common Energy Cost Exponent	−3	−2	0
Common Tariff Price Exponent	−4	−4	−4
Price for energy in Tariff 1	1567	1567	1567
Unit	EUR	EUR	EUR
Example of result, displayed	12.345 kWh 1,934 EUR	12.3 kWh 1.93 EUR	0.01 MWh 1 EUR

1 kWh Price in Tariff (1,2,3,4)

The price for 1kWh active energy in selected tariff. The entered value is multiplied with tariff price exponent: Tariff price = Price * 10 ^ Exponent.

1 kvarh Price in Tariff (1,2,3,4)

The price for 1 kvarh reactive energy in selected tariff. The entered value is multiplied with tariff price exponent: Tariff price * 10 ^ Exponent.

1 kVAh Price in Tariff (1,2,3,4)

The price for 1 kvarh reactive energy in selected tariff. The entered value is multiplied with tariff price exponent: Tariff price * 10 ^ Exponent.

LED Energy Counter

Set one of four different Energy counters, witch are connected to LED.

LED Number of pulses

Number of pulses per energy unit for LED.

LED Pulse Length (ms)

Pulse length for LED in milliseconds.

Measured Energy

For each of eight (8) counters different measured quantities can be selected. User can select from a range of predefined options referring to measured total energy or energy on single phase. Or can even select its own option by selecting appropriate quantity, quadrant, absolute or inverse function.

To energy counter also pulse / digital input can be attached. In this case Energy counter counts pulses from an outside source (water, gas, energy... meter).

Individual counter Resolution

The individual counter resolution additionally defines precision of a certain counter, according to settings of common energy counter resolution.

Tariff Selector

Defines tariffs where counter is active.

Tariff Clock

Basic characteristics of a program tariff clock:

- 4 tariffs (T1 to T4)
- Up to 4 time spots in each Day program for tariff switching
- Whichever combination of valid days in a week or holidays for each program
- Combining of day groups (use of over 4 time spots for certain days in a week)
- Separate settings for 4 seasons a year
- Up to 20 settable dates for holidays

Day program sets up to 4 time spots (rules) for each day group in a season for tariff switching. **A date of real time clock** defines an active period. An individual period is active from the period starting date to the first next date of the beginning of other periods.

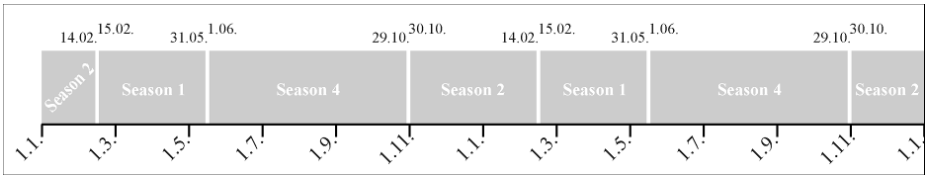
The order of seasons and starting dates is not important, except when two dates are equal. In that case the season with a higher successive number has priority, while the season with a lower number will never be active.

If no starting date of a season is active, the active period is 1.

If the present date is before the first starting date of any period, the period is active with the last starting date.

Example of settings:

Season	*Season start day*
Season 1:	15.02
Season 2:	30.10
Season 3:	-
Season 4:	01.06
Date	*Active season*
01.01. - 14.02.	2 (last in the year)
15.02. - 31.05.	1
01.06. - 29.10.	4
30.10. - 31.12.	2



Days in a week and selected dates for holidays define time spots for each daily group in a period for tariff switching. Dates for holidays have priority over days in a week.

When the real time clock date is equal to one of a date of holidays, tariff is switched to holiday, within a period of active daily group with a selected holiday.

If there is no date of holidays that is equal to the real time clock date, all daily groups with the selected current day in a week are active.

Several daily groups can be active simultaneously, which enables more than 4 time spots in one day (combine of day programs). **If the time spot is not set for a certain day, tariff T1 is chosen**.

Time of a real time clock defines an active tariff regarding currently active day program. A selected tariff T1 to T4 of individual time spot is active from the time of the time spot to the first next time of the remaining time spots.

The order of time spots is not important, except when two times are equal. In that case the time with a higher successive number has priority (if several time spots are active, times of higher time spots have higher successive numbers), while the time spot with a lower number will never be active.

If current time is before the first time of any time spot of active spots, the time spot with the last time is chosen.

If no time spot of active programs is valid, tariff T1 is chosen.

Time selected tariff T1 to T4 or fixed selected tariff (via communication) defines activity of an energy counter.

Holidays/Holiday date 1-20

Year days (holidays) with the special cost management rules.

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Active Tariff:

OK Main menu > Settings > Energy > Active tariff

Common Energy Counter Resolution:

OK Main menu > Settings > Energy > Common en. exponent

LED Energy Counter:

OK Main menu ⇒ Settings ⇒ Energy ⇒ LED Counter

Led Number of pulses:

OK Main menu ⇒ Settings ⇒ Energy ⇒ LED No. of pulses

LED Pulse Length (ms):

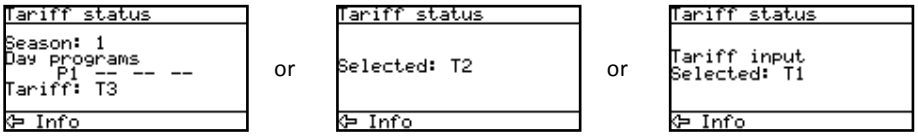
OK Main menu ⇒ Settings ⇒ Energy ⇒ LED Pulse lenght

Tariff Clock:

Main menu ⇒ Settings ⇒ Energy ⇒ Tariff Clock

Example of display for selected Active tariff:

Main menu > Info OK ⇓⇓⇓⇒



Inputs and outputs

Introduction

I/O functionality is a powerful tool of measuring instrument Using various I/O modules device can be used not only for monitoring main electrical quantities but also for monitoring process quantities (temp., pressure, wind speed…) and for various control purposes.

Welcome

Device can be equipped with different I/O modules with different functionality. For its technical specifications see chapter Technical data.

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I/O Modules

The following I/O modules are available:

MODULE TYPE	*SLOT*	*NUMBER I/O /SLOT*
AO	1,2	2
AI	1,2	2
AL	1,2	2
PO	1,2	2
PI	1,2	2
TI	1,2	2
BI	1,2	1
WO	1,2	1+1xalarm output

PLEASE NOTE

All modules have double input or output functionality, except Bistable alarm output and Watchdog output module. All modules with a double input or output are in MiQen presented as two separate modules.

An alarm output and a pulse output can also be selected with the keypad and display. When selecting settings of energy and quadrants for a certain counter, only preset selection is possible, while more demanding settings are accessible via communication. For other modules, information on a built-in module is available via LCD.

Analogue output module

Analogue output module is useful for control and measurement visualisation purposes. It can be connected to analogue meters, PLC controllers… It has defined output range 20mA DC. Quantity and shape (up to 6 break points) of an analogue output can be assigned by MiQen software.

Output parameter

Output parameter can be any measured value that is required for monitoring, recording, visualisation or control. Value is chosen from a drop-down menu.

Output signal

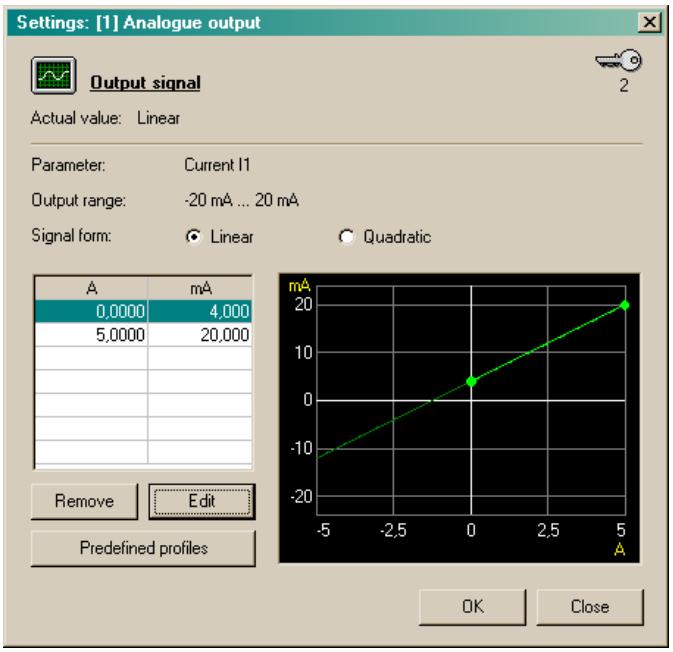
Output signal can be adjusted to meet all required purposes.

- Shape of output signal (linear, Quadratic)
- Number of break points for zoom function (up to 6)
- Start and End output value

For better visualisation of set output signal parameters, graphical presentation of transfer function is displayed.

Analogue output

Each of up to four analog outputs is fully programmable and can be set to any of 6 full-scale ranges. Within each of those 6 ranges, other required output ranges can be set. For example,
4 … 20 mA range can be set when ± 20 mA full-scale range is selected:



Output parameter

Set the measured parameter to be transformed onto the analog output.

Output range

Defines analog output full-scale ranges:

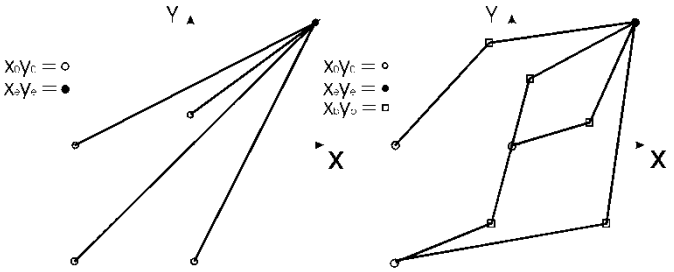
DC current output	*DC voltage output*
-1 … 0 … 1 mA	-1 … 0 … 1 V
-5 … 0 … 5 mA	
-10 … 0 … 10 mA	-10 … 0 … 10 V
-20 … 0 … 20 mA	

Output range

Defines the shape and up to 5 break points of an analog output. For intrinsic-error for analog outputs with bent or linear zoom characteristic multiply accuracy class with correction factor (c). Correction factor c (the highest value applies):

Linear characteristic	*Bent characteristic*
$c = \frac{1-\frac{y_0}{y_e}}{1-\frac{x_0}{x_e}}$ *or* $c = 1$	$x_{b-1} \le x \le x_b$ b – number of break points (1 to 5) $c = \frac{y_b - y_{b-1}}{x_b - x_{b-1}} \cdot \frac{x_e}{y_e}$ *or* $c = 1$

Example of settings with linear and bent characteristic:



Limit of the output range

Average interval for analog output

Defines the average interval for measurements on the analog output. Available settings are from 1 period (0.02 sec by 50 Hz) up to 128 periods (2.56 sec by 50 Hz).

Analogue input module

Three types of analogue inputs are suitable for acquisition of low voltage DC signals from different sensors. According to application requirements it is possible to order current, voltage or resistance (temperature) analogue input. They all use the same output terminals.

MiQen software allows setting an appropriate calculation factor, exponent and required unit for representation of primary measured value (temperature, pressure, flux…)

Signals from Analogue input can also be stored in built-in memory of a device. They can also be included in alarm function (see chapter *Alarms)*

DC current range:

Range setting allows bipolar ±20 mA max. input value

DC voltage range:

Range setting allows bipolar ±10 V max. input value

Resistance / temperature range:

Range setting allows 2000Ω or 200 Ω max. input value

It is also possible to choose temperature sensor (PT100 or PT1000) with direct translation into temperature (-200°C to +850°C). Since only two-wire connection is possible it is recommended that wire resistance is also set, when long leads are used.

Alarm output module

Alarm output module is a relay switch. Its main purpose is to be used as an alarm output, but can also be used as a pulse or general purpose digital output.

PLEASE NOTE!

A parallel RC filter with time constant of at least 250 µs (R·C ≥ 250 µs) should be used in case of a sensitive pulse counter. RC filter attenuates relay transient signals.

For description of output functionality see chapter Functions of Digital output modules.

General purpose digital output

This functionality allows user to enable / disable digital output by software settings for example from SCADA system.

For this operation MODBUS registers need to be accessed by means of software. By modifying appropriate MODBUS registers (from SCADA) digital output can be set or reset.

For corresponding MODBUS registers and their values see table below.

MODBUS registers and their values for remotely driving digital outputs:

MODULE NUMBER	*MODBUS REGISTER*	*REGISTER VALUE*	
Module 1 (if installed)	40722	3 - ON	4 - OFF
Module 2 (if installed)	40725	3 - ON	4 - OFF
Module 3 (if installed)	40728	3 - ON	4 - OFF
Module 4 (if installed)	40731	3 - ON	4 - OFF

Pulse output module

Pulse output is a solid state, opto-coupler open collector switch. Its main purpose is pulse output for selected energy counter, but can also be used as an alarm or general purpose digital output.

Calculation of recommended pulse parameters

Number of pulses per energy unit should be in certain limits according to expected power. Otherwise the measurement from pulse output can be incorrect. Settings of current and voltage transformer ratios can help in estimation of expected power.

Principle described below for pulse setting satisfies EN 62053−31: 2001 standards pulse specifications:

$$1{,}5 \ldots 15 \text{ eW} \rightarrow 100 \text{ p/1 eWh}$$

e … exponent (k, M, G)

p … pulses

Examples:

Expected power	→	*Pulse output settings*
150 − 1500 kW	→	1 p / 1kWh
1,5 − 15 MW	→	100 p / 1MWh
15 − 150 MW	→	10 p / 1MWh
150 − 1500 MW	→	1 p / 1MWh

Digital input module

Module has no settings. General purpose is to collect digital signals from various devices, such as intrusion detection relay, different digital signals in transformer station, industry ... It is available in three different hardware versions.

It can also be included in alarm function (see chapter *Alarms).*

Pulse input module

Module has no settings. It is general purpose pulse counter from external meters (water, gas, heat …). Its value can be assigned to any of four energy counters. See chapter *Energy.* It can also be used as digital input and included in alarm function to monitor signals from different sensors (see chapter *Alarms*).

Pulse input module has only one hardware configuration (5…48 V DC).

Tariff input module

Module has no setting. It operates by setting active tariff at a tariff input (see chapter Tariff clock). The device can have maximal one module with 2 tariff inputs only. With the combination of 2 tariff inputs maximal 4 tariffs can be selected.

Active tariff selection table:

Active tariff	*Signal presence on tariff input*	
	Input T1	Input T2
Tariff 1	0	0
Tariff 2	1	0
Tariff 3	0	1
Tariff 4	1	1

Bistable alarm output module

A Bistable alarm module is a relay type. The only difference between relay alarm output and bistable relay alarm output is that it keeps the condition at output in case of device power failure.

Alarm Output

If Digital output is defined as an Alarm output, its activity (trigger) is connected to Alarm groups. Multiple alarm groups can be attached to it and different signal shapes can be defined. For more information on how to define alarm groups, see chapter *Alarms.*

Main menu > Settings > Inputs/Outputs > I/O 1 / 2 / 3 / 4 > (Settings of alarm output)

Two parameters should be defined for each alarm output:

The source for assigned alarm (alarm group 1, 2 or both)

Type of output signal when alarm is detected.

Output signal types

Normal – A relay is closed as long as condition for the alarm is fulfilled.

Normal inverse – A relay is open as long as condition for the alarm is fulfilled. After that relay goes to closed state

Latched – A relay is closed when condition for the alarm is fulfilled, and remains closed until it is manually reset.

Latched inverse – A relay is open when condition for the alarm is fulfilled, and remains open until it is manually reset.

Pulsed – an impulse of the user set length is activated always when condition for the alarm is fulfilled.

Pulsed inversed – Normally relay is activated. An impulse of the user set length deactivates it always when condition for the alarm is fulfilled.

Always switched on / off (permanent) – A relay is permanently switched on or off irrespective of the condition for the alarm (general purpose digital output functionality).

Check an example in chapter *Alarms* for graphical demonstration of alarm functionality.

Status (Watchdog) and Relay output module

Watchdog and relay module is a combination of two functionalities. One output is used for Watchdog functionality, the other acts as a Relay output module.

The purpose of a Watchdog relay is to detect potential malfunction of device or auxiliary power supply failure. This module can be set for normal operation (relay in close position) or for test purposes to open position (manual activation). After test module should be set back to normal operation.

For description of output functionality see chapter Functions of Digital output modules below.

Fast analog output module

Functionality of fast analog output module is the same as with standard analog output module.

The only difference is its faster response time (≤ 50 ms), and consequential higher ripple. For a proper behavior of fast analog output module (fast response), average interval shall be set to minimum (1 periode).

2nd Communication module (COM2)

Module is preset for RS485 communication on I/O 4 terminals.

Module settings define parameters that are important for the operation in RS485 network. Factory settings of communication are #33\115200,n,8,2 (address 1 to 247\rate 2400 to 115200 b/s, parity, data bits, stop bit). By default, addresses of COM1 and COM2 are the same (#33). In this case, change of COM1 address sets COM2 to the same address. When COM1 and COM2 addresses are not equal, change of COM1 address has no influence on COM2 address. Change of COM2 address has no influence on COM1 address. (U)MT5xx can be connected to the same network using COM1 or COM2 (if available).

Auxiliary I/O Modules A & B

MC774 Quality Analyser is equipped with two auxiliary I/O slots. The biggest difference in functionality between main and auxiliary I/O modules is in response time. Digital inputs and outputs do not have as fast response time as with main I/O modules.

The following auxiliary I/O modules are available:

List of available auxiliary I/O modules

Module type	*Number of modules per slot*
Digital output (DO)	8

Digital input (DI)	8

State of the built in input and/or output module can be monitored also via LEDs on the front panel of the device.

Digital input module

Module has no settings. Their purpose is to collect digital signals from various devices, such as (intrusion detection relay, different digital signals in transformer station, industry …).

According to input voltage range it is available in three different hardware versions. For technical specifications see chapter *Technical data.*

Digital input can also trigger an alarm (see chapter *Alarms).*

State of digital inputs can also be monitored for control purposes with SCADA system by reading appropriate MODBUS registers.

Relay output module

Relay output module is a relay switch. Its main purpose is to be used as an alarm output.

For the difference to Relay output module of main I/O module 1 or 2, also a single alarm can be used to trigger each output (when using Relay output module of main I/O module 1 or 2 only a single or a combination of alarm groups can be used as a trigger for each output).

For additional information regarding alarms, see chapter *Alarms.*.

RTC Synchronization module C

In order use Module C for synchronisation purposes it has to be defined as a synchronisation source. See chapter *Real time synchronisation source.*

CAUTION

RTC synchronisation is essential part of Class A instrument. If no proper RTC synchronisation is provided device operates as Class S instrument.

Quality Analyzer MC774 supports three types of RTC synchronization:

- GPS time synchronisation (via Synchronisation module C)
- IRIG-B time synchronisation (via Synchronisation module C)
- NTP time synchronisation (via Ethernet module)

Instructions regarding connection of Synchronisation module C can be found in chapter *Connection of Synchronisation module C*.

PLEASE NOTE

Serial communication built in Synchronisation module C can, under certain conditions, be used as an independent secondary communication.

GPS time synchronization

For proper GPS synchronisation two signals are required.

- 1pps with TTL voltage level and
- NMEA 0183 coded serial RS232 communication sentence

GPS interface is designed as 5 pole plugable terminal (+5V for receiver supply, 1pps input and standard RS232 communication interface).

Proposed GPS receiver is GARMIN GPS18x

PLEASE NOTE

When connecting GPS to serial RS232 communication interface please take into consideration required communication parameters. For proposed GPS receiver default communication speed is 4800 b/s.

IRIG time code B (IRIG-B)

Unmodulated (DC 5V level shift) and modulated (1 kHz) serial coded format with support for 1pps, day of year, current year and straight seconds of day as described in standard IRIG-200-04.

Supported serial time code formats are IRIG-B007 and IRIG-B127. For technical specifications see chapter *Technical data.*

Serial communication (COM2)

If device uses RTC synchronisation over NTP server (via Ethernet module), IRIG-B or only 1PPS without date synchronisation, serial communication port of RTC Synchronisation module C is free to be used as a secondary communication port COM2. Either RS232 or RS485 communication can be used. COM1 and COM2 are completely independent and can be used for the same purpose and at the same time.

Module settings define parameters, which are important for the operation in RS485 network or connections with PC via RS232 communication.

Factory settings for serial communication COM2 are:

MODBUS Address	#33	address range is 1 to 247	
Comm. speed	4800	speed range is 2400 to 115200	
Parity	none		
data bits	8		
stop bits	2		

PLEASE NOTE

By default, addresses of COM1 and COM2 are the same (#33). In this case, change of COM1 address sets COM2 to the same address. When COM1 and COM2 addresses are not equal, change of COM1 address has no influence on COM2 address and change of COM2 address has no influence on COM1 address.

Settings of RTC Synchronisation module C

In order to enable synchronisation with GPS or IRIG time code a proper Real Time synchronisation source should be defined as described in a chapter General settings/Real Time synchronisation source.

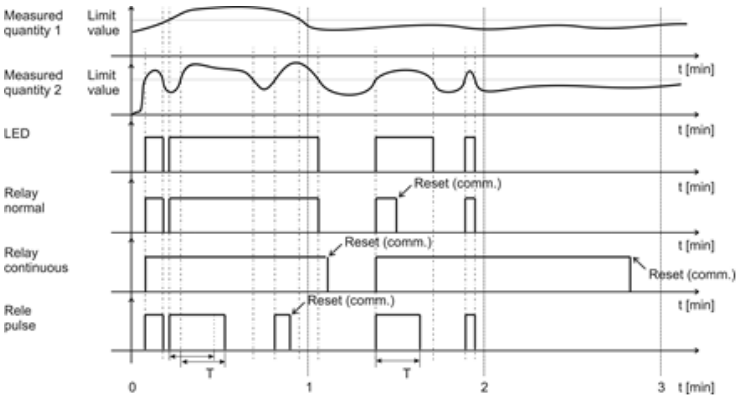
Alarms

Alarms are used for alarming exceeded set values of measured quantities and quantities from different input modules.

Alarms can also trigger different actions according to their settings:

- Visual (alarms cause special alarm LED to it)
- When alarm is switched on a red LED on the device front side is blinking. See figure below.
- Sound (alarms can cause sound signalisation)
- When alarm is switched on, an audible alarm is given by the device (a beep). It cen be switched off by pressing any key on the front plate (see figure below).
- Alarm ouput (alarms can switch digital outputs on main and aux. I/O modules)
- According to the alarm signal shape the output relay will behave as shown on figure below.

Alarm condition can be set for any measured quantity, also for quantities measured on Analogue inputs or signals from Digital / Pulse input.



CAUTION

New values of alarms are calculated in percentage. At every modification of connection settings crosscheck if set alarm values are correct.

Alarms PUSH functionality

When PUSH communication mode is active, all alarms can be sent (pushed) to a predefined location inside local or wide area network. Settings allow choosing an appropriate destination for alarm data to be sent.

Alarm data is sent to the server immediately as alarm(s) occur. If they cannot be sent immediately due to communication problems, they are sent at next alarm event or data sending interval (whichever occurs first).

Alarms and time stamps of occurrence are also stored into internal memory.

For more information about PUSH functionality and XML data format see chapter PUSH Communication mode

Push data to link

When PUSH communication mode is used a data receiving server (client) link should be defined. Data can be sent (according to a type of used communication interface) to COM1, TCP link 1 or TCP link 2. For definition of PUSH links see *PUSH communication settings*. Alarms are unlike recorded values sent to chosen link immediately after occurrence. Therefore settings for pushing period and time delay are not applicable.

Pushing period

Defines a time period for pushing data to clients. Readings, events and PQ reports, which are recorded in internal memory, can be also periodically (user defined) sent to a client. For more information about Push system see Users manual.

Pushing time delay

Defines if data should be send immediately after pushing period condition achieved, or a time delay is used for client discharge.

Alarms group settings

Measuring instrument supports recording and storing of 32 alarms that are divided into 4 groups of 8 alarms. Each group of alarms has some common settings applicable for all alarms within this group.

Alarm settings

Measuring centre supports alarm functionality. 16 alarms divided in 2 groups (2 x 8 alarms) can be set. For each group of alarms a time constant of maximal values in thermal mode, a delay time and alarm deactivation hysteresis can be defined.

Quantity, value (a current value or a MD – thermal function) and a condition for alarm switch-on are defined for every individual alarm.

MC350 TH also supports storing of alarms in internal memory.

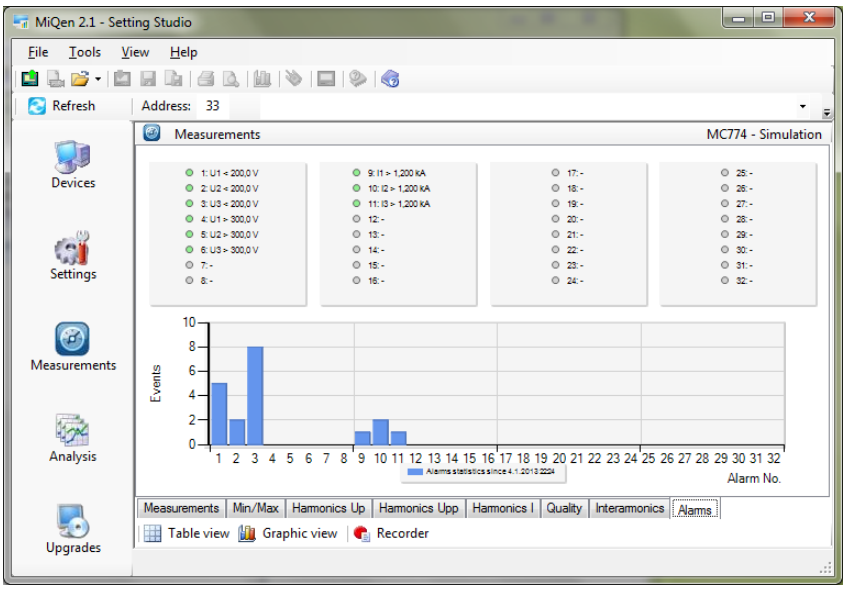
WARNING!

New values of alarms are calculated in percentage at modification of connection settings.

Alarm statistics reset

Device evident all triggered alarms and stores it in internal RAM. Statistic is valid since last power supply On and could be reset with MiQen - help tip software (See chapter Reset operations).

This setting is only for resetting online alarms statistics displayed in MiQen - help tip software.



Alarms statistics for showing graphical representation of frequency of alarms occurrence.

MD Time constant (min)

Sets a thermal mode maximum demands time constant for the alarm group. When monitoring certain quantity it is possible to monitor its actual value or its max. demand value. If latter is chosen then a time constant for calculation of thermal mode max. demand value should be set. This setting is for alarm purposes only and is independent of max. demand calculation settings for monitoring and recording purposes as described in chapter Maximum demand calculation.

Compare time delay (sec)

This setting defines delay time (if required) between satisfying the alarm condition and alarm activation. If alarm condition is shorter then this setting alarm will not be triggered. This setting is used to rule out sporadic and very short duration triggers.

Histeresis (%)

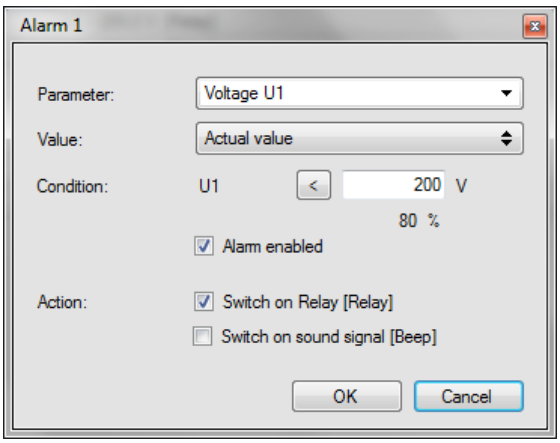
This setting defines alarm deactivation hysteresis. When monitord quanitity is close to set limit line its slight variation can trigger numerous alarms. Hysteresis should be sett according to estimated variation of monitored quantity.

Response time

This setting defines alarm response on monitored quantity. Normal response: In this case monitored quantity is averaged according to display averaging settings (0.1 to 5s – see chapter General settings / Average interval)
Fast response: In this case alarms react on non-averaged measurements (1 signal period). This setting should be used according to required functionality. Fast response is more prone to glitches and transient effects in a system but reaction time is fast.

Individual alarm settings

For each individual alarm different settings are possible.



Individual Alarms settings

Parameter

This setting defines a quantity that should be monitored. It is also possible to select process quantities from I/O modules.

Value

For chosen monitoring parameter an actual value or MD value should be set.

Condition

It is a combination of a logical operator “Higher than” or “Lower than” and a limit value of the condition. For digital / pulse input it is possible to set condition is “Is high” or “Is low”.

Action

This section is consists of checkboxes that applies different functions to individual alarms.

Switch on Relay checkbox can be selected if user wants this alarm to trigger output(s) that are connected to its group of alarms (pulse, relay or bistable output module). When using relay outputs of I/O module A or B also a single alarm can be used as a trigger. In this case Switch on Relay setting has no influence.

Switch on sound signal checkbox would activate built in beeper if this alarm is active.

Alarm enabled checkbox, activates alarm setting.

Memory/Recorders

Introduction

Measurements, alarms, PQ reports and details can be stored in a built in memory of measuring instrument 8MB flash. This amount of memory suffices for storing EN 50160 compliant PQ reports with details for more than 12 month. All records stored in memory are accessible by communication or memory card and can be displayed with MiQen software.

Device has also a built in function that enables scheduled transmission of data, stored in memory, to remote data collecting system. For more information regarding this feature see chapter *PUSH Communication mode.*

Intrduction to Memory/Recorders

Measurements and alarms are stored in a built in memory in the 8MB flash. All records stored in memory are accessible via communication or memory card with MiQen software. Device also has a built in function that enables scheduled transmission of data, stored in memory, to MiSmart system. For more information regarding this check chapter PUSH Communication mode.

Welcome

Measurements, alarms, reports and details of supply voltage quality are stored in a built in memory in the 8MB flash. All records stored in memory are accessible via communication or memory card with MiQen software. Device also has a built in function that enables scheduled transmission of data, stored in memory, to MiSmart system. For more information regarding this check chapter *PUSH Communication mode*.

Reserved for network quality

Reserved memory for the network quality analysis.

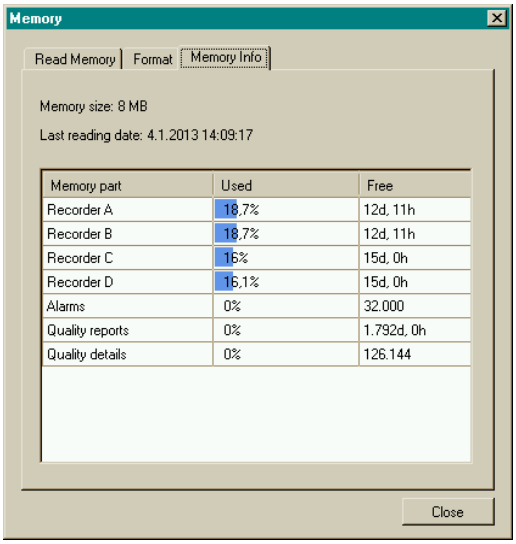
Memory organisation

Devices' internal memory has 8MB of total memory space. It is divided into 5 partitions which size is defined by the user and 2 fixed partitions.

User defined partitions are A, B, C and D recorders that are intended for recording of measurements, while all alarms that occurred are recorded in an alarm partition.

C and D recorders can be user defined as a standard trend recorders (like recorders A and B) or can be defined as dedicated harmonic recorders. As such they will record all 63 harmonics, voltage or current depends on user setting for each of those two recorders. Settings are available in general tab of Standard recorders section (see figure Internal memory organisation).

Fixed partitions are dedicated for recording PQ reports and details (see chapter Power supply quality).



Internal memory organisation

Memory division

Memory is divided into 5 partitions which size is defined by the user. The A, B, C and D recorders are intended for recording measurements, while all alarms that occurred are recorded in an alarm partition.

Memory division MC350

MC memory is divided into 3 partitions which size is defined by the user. Measurements are stored in A and B partitions, while all alarms that occurred are recorded in an alarm partition.

Recorder A/B state

Defines if data is storing to selected memory partition.

Recorder A/B/C/D state

Defines if data is storing to selected memory partition.

Alarms state

Defines if data is storing to selected memory partition.

Quality reports state

Defines if data is storing to selected memory partition.

Quality details state

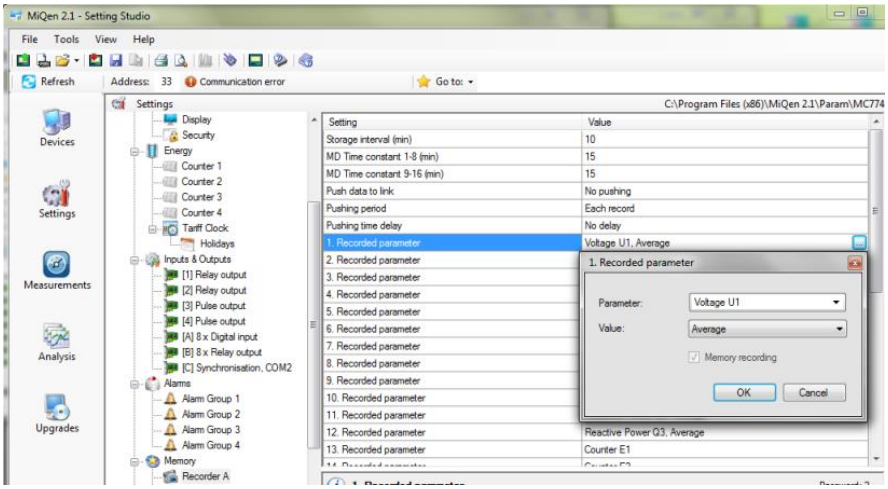
Defines if data is storing to selected memory partition.

Recorder C/D mode
Defines function mode for the recorder.

Trend recorder A/B
Separately, for each of the recorders, settings can be set.

Trend recorder A/B/C/D
General purpose recorder consists from 4 partitions (A, B, C and D). General purpose recorder does not include alarm recorder or PQ reports and details recorder. Separately, for each of four partitions, following settings can be set:

Recorded quantites
For each of measurement, which is to be recorded it is possible to set a required quantity and its type within storage interval (min., max., avg. …)..



Stored parameter settings

Storage interval (min)
Which type of parameter should be stored each interval (avg., min., max., actual…) is defined in settings for each individual parameter described later in this chapter.

Value
A type of a selected quantity within set monitoring interval can be set to different conditions.

Minimum and Maximum value represents minimum or maximum of recorded averaged values within selected storage interval. Note that min./max. value is not a single period value but an average (0.1 s to 5 s; see chapter General settings / Average interval).

Minimum (MD) and Maximum (MD) value represents calculation of a MD value with applied thermal function. Thermal function time constant is described above (MD Time constant). It applies only to recorders A and B

Average value represents calculated average value within selected storage interval

Actual value represents first momentary value within selected storage interval. Note that momentary value is not a single period value but an average (0.1 s to 5 s; see chapter General settings / Average interval). It applies only to recorders C and D.

Minimum and Maximum (Period) values represent min. or max. value within selected storage interval calculated in a single period. This function allows recording of very fast changes. It applies only to recorders C and D.

Value for mc350
Representation of a value within set monitoring interval can be set to different conditions.

Average value represents calculated average value

Actual value represents value of recorded quantity at sampling intervals

Minimum and Maximum value represents minimum or maximum of recorded quantity in selected storage interval. Minimum or maximum in this case represents averaged value according to average interval selected in General settings.

MD time constant 1-8 and 17-24 (min)

When max. demand needs to be recorded, this setting sets a period for calculation of maximum and minimum value in thermal mode (Minimum (MD) or Maximum (MD)). Different parameters can be set for Recorded parameters 1-8, 17-24 and 9-16, 25-32. This setting is only available for recorders A and B.

MD time constant 9-16 and 25-32 (min)

When max. demand needs to be recorded, this setting sets a period for calculation of maximum and minimum value in thermal mode (Minimum (MD) or Maximum (MD)). Different parameters can be set for Recorded parameters 1-8, 17-24 and 9-16, 25-32. This setting is only available for recorders A and B.

Push settings

When PUSH communication mode is active, all measurements which are set to be written to the memory can be sent (pushed) to a predefined location inside local or wide area network (from the time that PUSH functionality has been activated, not for the past records). Settings allow choosing an appropriate destination for data to be sent, time interval of sent data and a delay time for sending data if they cannot be sent immediately due to restrictions in network.
For more information about PUSH functionality see chapter PUSH Communication mode.

Push settings: Push data to link

Defines the communication channel for pushing data to clients.

Push settings: Pushing period

Defines a time period for pushing data to clients. Reading, events and PQ reports, witch are recorded in internal memory, can be also periodically (user defined) sent to a client. For more information about Push system see Users Manual.

Push settings: Pushing time delay

Defines if data should be send immediately after pushing period condition is achieved or a time delay is used for client discharge.

Recorder parameter (1-16)/(1-32)

Monitoring quantity can be selected from a list of supported measurements.

Recorder measurements group

Defines the measurements which will be recorded.

Memory operation

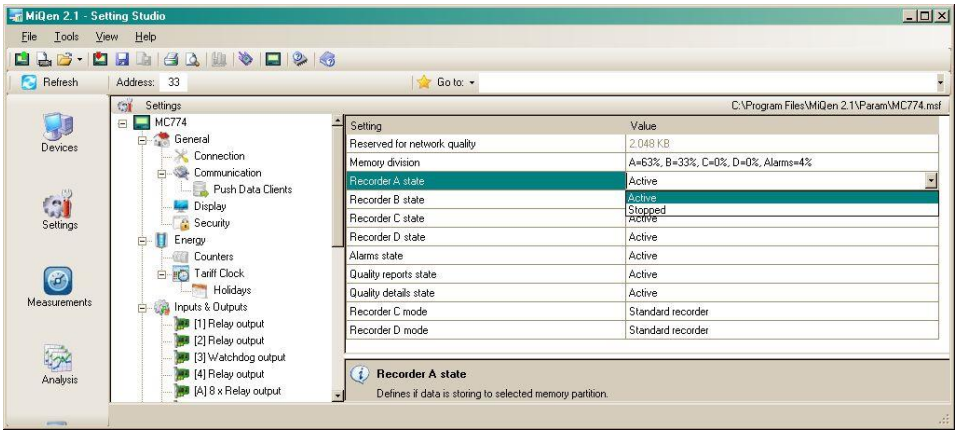
Memory functions in a cyclic mode in compliance with the FIFO method. This means that only the latest records are stored in the memory that will replace the oldest ones.

A size of stored data or a storing period depends on selected partition size, a number of recorded quantities and a storage interval.

Storage availability of partitions is shown in the Information menu (see chapter Display of device info).

Memory clearing

There is usually no need to clear the memory, because it works in cyclic mode. If it is required anyway, the data storing must be stopped first. Read the device settings with MiQen and set “Recorder state” in Memory setting group to “stopped” as shown in a figure below.



Enabling or disabling data storage

Download changes to the device and open Memory info form and Format tab. Choose memory partitions required to be cleared and click format button. After partitions are cleared set “Recorder state” setting back to active.

CAUTION

It is strongly advised to download recorder data before applying any changes to recorder or changes of settings for energy, type of connection, current and voltage transformer settings and used current and voltage ranges. These changes might have impact on recorded history so data might no longer be valid.

Conformity of voltage with EN 50160 standard

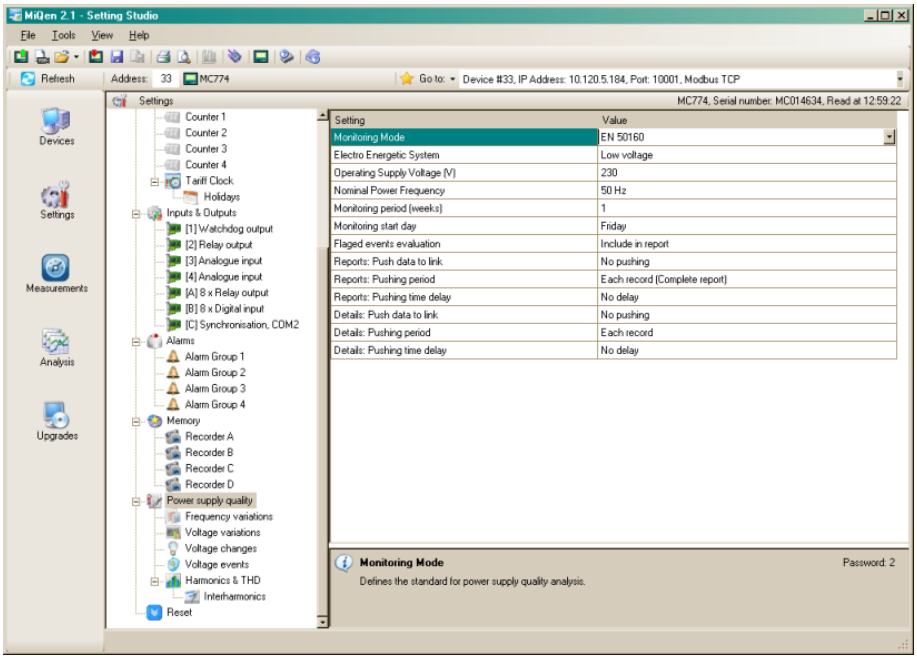
The EN 50160 standard deals with voltage characteristics of electricity supplied by public distribution systems. It specifies the limits or values of voltage characteristics in normal operation within public low or middle voltage system network. Fallowing this definition the measuring instrument is adapted for monitoring voltage characteristics of a distribution systems according to EN 50160 standard. Together with setting and monitoring software MiQen voltage characteristics can be monitored and weekly reports about power quality are issued.

Based on requirements stated in the standard, default parameters are set in the device according to which supervision of all required characteristics is performed. Parameters can also be changed in detailed settings for individual characteristics.

CAUTION

Factory default settings for PQ characteristics are in compliance with standard EN 50160. By changing individual parameters conformity of weekly reports with this standard is no longer valid.

Parameters of PQ characteristics are settable only by means of setting software MiQen.



General PQ settings

General PQ settings are basic parameters that influence other settings.

Monitoring mode

Monitoring mode can be set to:

-EN50160: Monitoring according to EN 50160 enabled. Weekly reports are issued according to set parameters

-No monitoring: Weekly reports for network compliance with the standard are disabled

Electro energetic system

Requirements for PQ monitoring differ regarding type of a monitored public distribution system. Therefore it is essential o choose proper type. This setting influences some of the predefined limit lines according to relevant standard EN 50160.

Measuring instrument can monitor PQ within following systems:

- Low Voltage grid connected system
- Medium Voltage grid connected system
- Low Voltage islanded system
- Medium Voltage isladed system

PLEASE NOTE

Choosing one of listed distribution systems automatically sets PQ characteristics according to requirements in EN 50160 for that particular system.

Nominal supply voltage

Set a voltage level of a monitored system. This value is used as a reference for calculation of power quality indices and is usually equal to nominal network voltage (also marked as Udin in various standards). Factory default value is EU standard low voltage value 230 V.

Nominal power frequency

Nominal frequency of monitored supply voltage is selected. Factory default value is EU standard frequency 50Hz. It is also possible to choose 60 Hz.

Flicker calculation function

Low voltage level for residential lamps can be either 230V or 110V. Function for detection of flicker differs regarding this voltage. Since actual low voltage level can be different as secondary voltage of used VT (nominal measuring voltage) this setting must be set to a voltage level, which is used to supply residential lamps.

Monitoring period (weeks)

Monitoring period predefines period for issuing PQ reports. When Monitoring Mode is set to EN 50160, monitoring is performed continuously.

This setting defines how often should reports be issued.

Monitoring start day

A starting day in a week for monitoring period is selected. It starts at 00:00 (midnight) in the selected day. The selected day will be the first day in a report.

After Monitoring period and Monitoring start day are defined, PQ reports will be continuously issued at the end of each monitoring period. All reports and associated anomalies within monitored period are stored in devices internal memory and can be analysed by means of MiQen software.

Flagged events setting

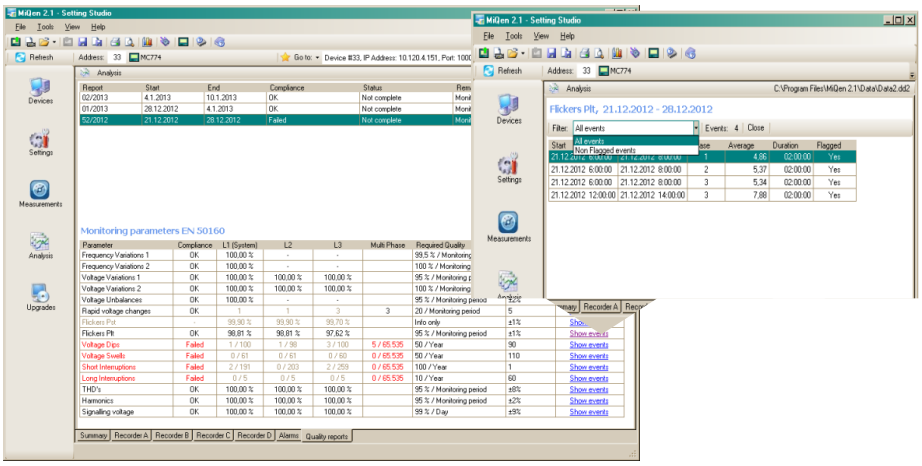
Flagged evens setting specifies actions on data (recorded events) that has been flagged (marked) according to flagging concept IEC 61000-4-30.

Flagged data are power quality records, which has been influenced by one or more voltage events (interruptions, dips, swells).

The purpose of flagging data is to mark recorded parameters when certain disturbances might influenced measurements and caused corrupted data. For example, voltage dip can also trigger occurrence of flicker, interharmonics... In this case all parameters which were recorded at a time of voltage events are marked (flagged). In later evaluation those flagged records can be omitted from final report by choosing appropriate setting.

PLEASE NOTE

Regardless of this setting, readings will be always stored in recorder and available for analysis. Flagging only influences PQ reports as a whole.



Flagged data can be included or excluded from a PQ report

Sending Reports and Report Details

When PUSH communication mode is active, reports about quality and report details for each parameter can be sent (pushed) to a predefined location inside local or wide area network. Settings allow choosing an appropriate destination for data to be sent, time interval of sent data and a delay time for sending data if they cannot be sent immediately due to restrictions in network.

For more information about PUSH Communication mode.

EN 50160 parameters settings

Power Quality indices as defined by EN 50160

Phenomena	*PQ Parameters*
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation

	Voltage unbalance
Voltage changes	Rapid voltage changes
	Flicker
Voltage events	Voltage dips
	Voltage interruptions
	Voltage swells
Harmonics & THD	THD
	Harmonics
	Inter-harmonics
	Signalling voltage

Standard EN 50160 describes in details PQ parameters and corresponding limit lines for monitoring whereas distribution system voltage operates in accordance with mentioned standard.

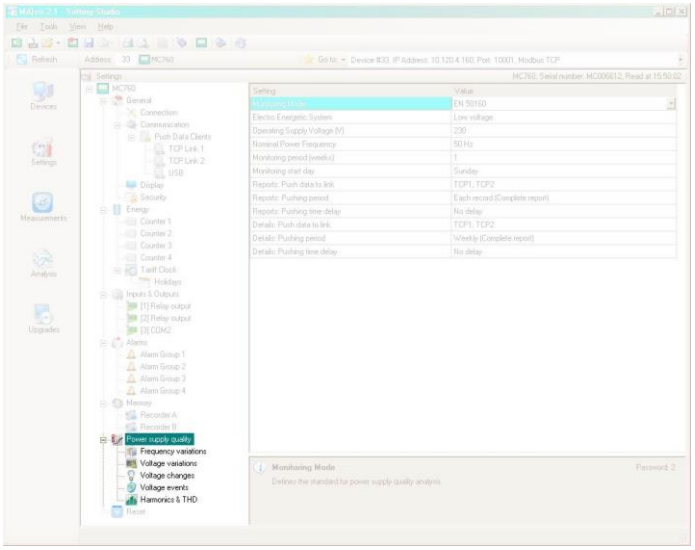
Settings of limit lines and required percentage of appropriate indices resembles requirements of standard EN 50160.

When monitoring according to this standard is required there is no need to make changes to PQ parameters settings.

More detailed description of certain parameter monitoring procedures is in a chapter *Measurments*.

There are some PQ parameters which are interesting for monitoring but are not required to be part of PQ reports. These settings do not have standardised limit values and an be set according to distribution network requirements.

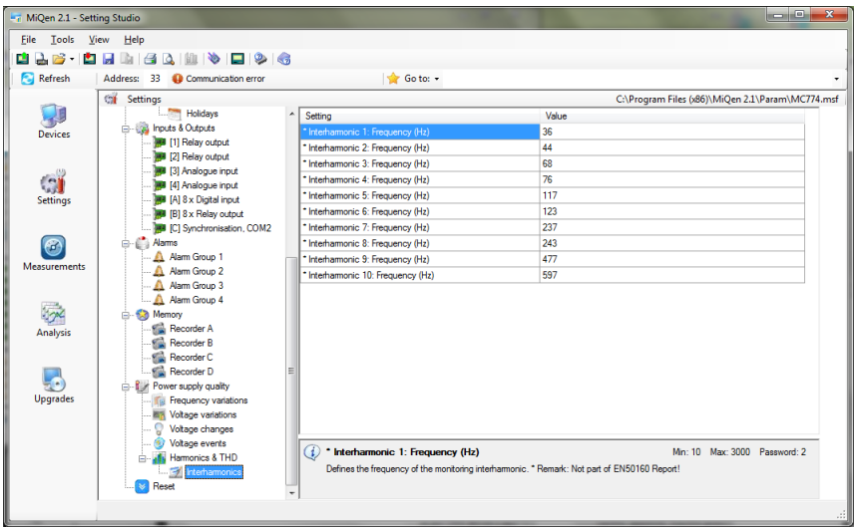
- Short term flicker (limit Pst = 1)
- Interharmonics (10 values of user defined frequencies)



Settings for power quality parameters are set with setting and monitoring software MiQen

MiQen HELP description clearly marks PQ parameters, which are not required as a part of EN 50160 PQ report.

Below figure shows settings for interharmonic values:



Settings for 10 user defined interharmonic frequencies

Conformity of voltage with SIST EN 50160 standard

The SIST EN 50160 standard deals with voltage characteristics of electricity supplied by public distribution systems. This specifies the limits or values within which a customer can expect voltage characteristics to lie. Within this definition the Network analyzer is adapted for supervising the compliance of distribution systems with the SIST EN 50160 standard.

Based on requirements stated in the standard, default parameters are set in the meter according to which supervision of all required parameters is done. Parameters can also be changed in detailed setting of individual characteristic.

Reset

During normal operation of a device different counter s values need to be reset from time to time.

Reset energy counter

All or individual energy meters (counters) are reset.

Reset energy counter Cost

All or individual energy costs are reset.

Reset MD values

Thermal mode:

Current and stored MDs are reset.

Fixed interval / Sliding windows:

The values in the current time interval, in all sub-windows for sliding windows and stored MD are reset. In the same time, synchronization of time interval to the beginning of the first sub-window is also performed.

Reset last period MD

Thermal mode:

Current MD value is reset.

Fixed interval / Sliding windows:

Values in the current time interval and in all sub-windows for sliding windows are reset. In the same time, synchronization of the time interval is also performed.

Synchronize MD

Thermal mode:

In this mode, synchronization does not have any influence.

Fixed interval / Sliding windows:

Synchronization sets time in a period or a sub-period for sliding windows to 0 (zero). If the interval is set to 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes, time in a period is set to such value that some intervals will be terminated at completed hour.

Time constant (interval)	15 min	10 min	7 min
Synchronization start time	10:42	10:42	10:42
Time in a period	12 min	2 min	0 min

First final interval	10:45	10:50	10:49

Alarm relay [1/2/3/4] Off

When using MiQen, each alarm output can be reset separately. On device (manually) only all alarm outputs together can be reset.

Reset Min/Max values

All Min/Max values are reset.

Reset alarm statistic

Clears the alarm statistic. It can be made by MiQen software under Alarm settings. This setting is only for resetting online alarms statistics displayed in MiQen software.

Reset alarm output

All alarms are reset.

LCD navigation

Reset energy counter: LCD navigation

Main menu > Resets > Energy counters > Energy counter E1 / E2 / E3 / E4

Reset energy counter Cost: LCD navigation

Main menu > Resets > Energy counters > All Cost counters / Cost counter E1 / E2 / E3 / E4

Reset MD values: LCD navigation

Main menu > Resets > MD values >Yes/No

Reset last period: LCD navigation

Main menu > Resets > Last period MD >Yes/No

Synchronize MD: LCD navigation

Main menu > Resets > Synchronize MD

Reset Min/Max values: LCD navigation

Main menu > Resets > Min/Max values >Yes/No

Settings and memory card

Measuring centre is provided with a built in slot for a full size SD memory card that is used for measurements transfer from internal memory, device setting and software upgrading. The memory card shall be formatted with the FAT16 file system.

Directory structure on a memory card

A structure of directories is defined and enables correct data handling via a memory card. The memory card shall contain the following directories and files:

- DATA
- SETTING
- UPGRADE
- File: Automenu.txt (option)

DATA

Records from the internal memory are collected in the DATA directory. To upload data of several devices to the memory card, each device checks and, if necessary, creates its own subdirectory before data transfer. Each subdirectory uses a device serial number as its name and stores files with data in it. Each file name contains date (year, month and day) and a record sequence number of that day.

WARNING

When uploading data file to memory card and there is a file with sequence number 99 of that day, a file with sequence number 00 is generated. File with sequence number 00 of that day, is overwritten in case of any further uploading data that day.

SETTING

Settings are stored in the directory using two recording modes:

- With a type designation and a sequence number from 1 to 9
- With an device serial number

UPGRADE

A file with upgrades is available for upload with the MiQen software. A file has a name of a corresponding device type designation and suffix fl2 (e.g. MC7XX.FL2).

Automenu.txt

For faster and easier upgrading of the firmware there is »Automenu.txt« file in the root directory. When an memory card with a file is inserted and if upgrade version is higher, display automatically jumps into the memory card menu and suggests the Software upgrade menu, otherwise it automatically jumps into the Save data menu. When upgrading is finished and the OK key is pressed and memory card is removed, the menu that was displayed before inserting the memory card is displayed.

Automenu.txt file can be created by the user by means of the text editor. A new file has to be opened and saved under the correct name (Automenu.txt) and without content.

Example:

DATA
↳ MC003973
↳ 06050301.MMC
MC003974
↳ 06050301.MMC
06070301.MMC
MC009424
↳ 06060301.MMC
06070301.MMC
SETTING
↳ MC003973.MSF
MC774−1.MSF
MC774−2.MSF
MC750−1.MSF
UPGRADE
↳ MC760.FL2
Automenu.txt

Handling memory card

Quality Analyser is on the front panel equipped with a slot for a Memory card. Slot is protected with a protection cover that can be simply removed before inserting the card. The protection cover shall be fixed back after work is done.

CAUTION

While memory card activity LED is blinking it should not be pulled out of the slot.

Save data

Sections

For each section define whether it is included for a record in a file.

Date

Since the last transfer, all available data from the last official reading with a password is included. For the Last week and the Last month, all data of the last complete unit (a week, a month) with the beginning in the first day at 00:00 is included. The selected date defines a day with the beginning at 00:00 from which further on to the current time of data transfer. When all data is selected, all data for an individual section, that are stored in the memory up to the moment when reading is started, are transferred.

Official reading

If official reading is selected date of reading is stored in device, and is applied at the next official reading.

Save settings

File of current device settings is stored in SETTING directory. File name consists of device serial number and MSF extension. In case of file already stored on memory card, the device warns if file should be overwritten.

Load settings

For loading settings, the files that correspond to the device type are displayed on LCD. When a file is selected, it is necessary to choose the segments of settings that will be overwritten. A number of registers that will be modified is written next to each segment. After settings transfer, a warning on errors could be displayed. Errors occur when the module setting and a memory capacity differ from the used ones in the device. A number of settings (registers) that do not match and are neither modified is displayed after warning.

Basic settings

At transfer of basic settings, settings of connections, ratios, used voltage and current ranges as well as nominal frequency are not changed. New settings can influence energy counters if recorded in a memory.

Alarms

Settings of all alarms are changed, but old alarms with previous settings remain in the memory.

Recorders

Recorder overwriting enables modified setting of connection, ratio, used voltage and current ranges as well as nominal frequency. All other data in a memory is lost.

Firmware upgrading

Before upgrading files on memory card are checked first, this can last some time (approx. 1 minute). When both versions are displayed, upgrade can be performed if the device software version is lower or equal to the version in a file.

WARNING

When upgrading firmware software remove memory card and do not interrupt power supply - the device could become inoperative!

Repairing of device in this case is to be done by authorized service.

Upgrade error codes:

Error 1: memory card not inserted

Error 2: Error on FAT16 file system

Error 3: File not exist (.fl2)

Error 4: Error in .fl2 file

Error 5: File too long (.fl2)

Error 6: Invalid file (.fl2)

Error 7: Incorrect upgrade version (.fl2)

LCD navigation:

Memory card information:

Device checks a file system and capacity of the inserted memory card.

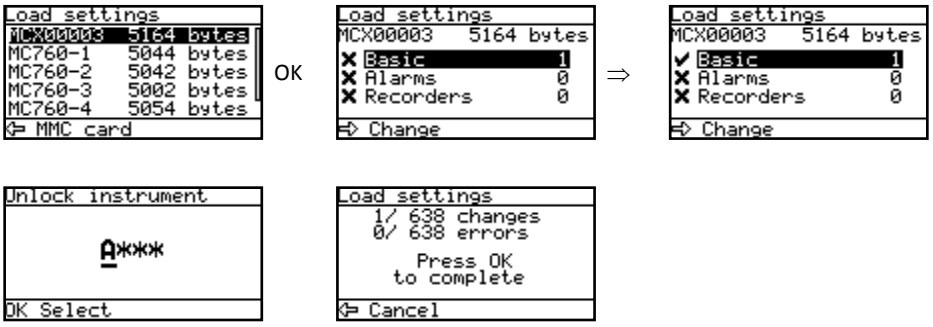
Main menu > SD card > SD info

Official reading - Example:

Main menu > SD card > Save data

Example of a display on LCD for MC774:

Main menu > SD card > Load settings



MEASUREMENTS

MC774 Quality Analyser performs measurements with a constant sampling frequency 31 kHz. Measurement methods differ for normal operation quantities, where values are averaged and aggregated according to aggregation requirements of IEC 61000-4-30 standard (Class A) and voltage events where half-period values are evaluated again according to Class A standard.

Online measurements

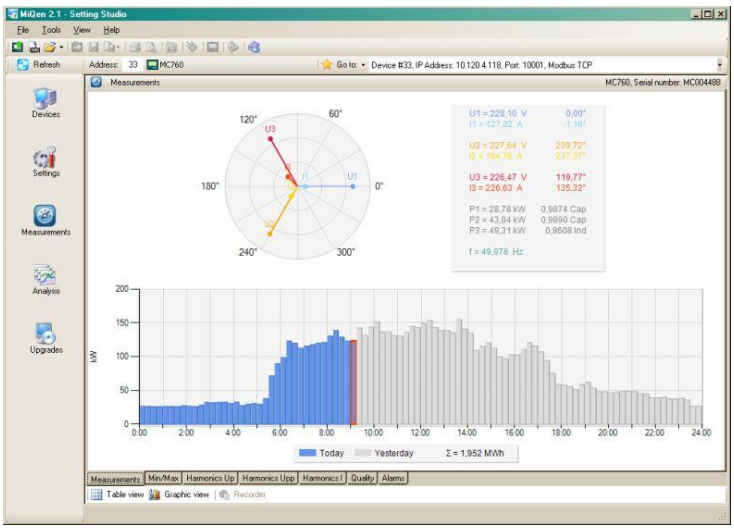
Online measurements are available on display or can be monitored with setting and monitoring software MiQen.

Readings on display are performed continuously with refresh time dependent on set average interval whereas rate of readings monitored with MiQen is fixed and refreshed approx. each second.

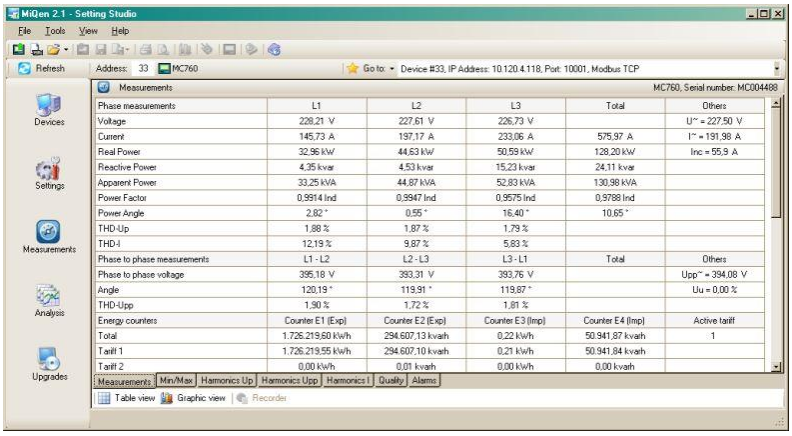
For better overview over numerous readings, they are divided into several groups, which contain:

basic measurements, min. and max. values, alarms, harmonics and PQ parameters (presented groups depend on measurements and function supported in selected device).

Each group can represent data in visually favoured graphical form or detailed tabelaric form. Latter allows freezing readings and/or copying data into various report generation software tools.



Exemple: Online measurements in graphical form - phaser diagram and daily total active power consumption histogram


MiQen 2.1 - Setting Studio
File Tools View Help
Refresh
Address: 33 MC760
Go to: Device #33, IP Address: 10.120.4.118, Port: 10001, Modbus TCP
Measurements
MC760, Serial number: MC004488
Devices
Settings
Measurements
Analysis
Upgrades
Phase measurements L1 L2 L3 Total Others
Voltage 228,21 V 227,61 V 226,73 V U~ = 227,50 V
Current 145,73 A 197,17 A 233,06 A 575,97 A I~ = 191,98 A
Real Power 32,96 kW 44,63 kW 50,59 kW 128,20 kW Inc = 55,9 A
Reactive Power 4,35 kvar 4,53 kvar 15,23 kvar 24,11 kvar
Apparent Power 33,25 kVA 44,87 kVA 52,83 kVA 130,98 kVA
Power Factor 0,9914 Ind 0,9947 Ind 0,9575 Ind 0,9788 Ind
Power Angle 2,82 ° 0,55 ° 16,40 ° 10,65 °
THD-Up 1,88 % 1,87 % 1,79 %
THD-I 12,19 % 9,87 % 5,83 %
Phase to phase measurements L1 - L2 L2 - L3 L3 - L1 Total Others
Phase to phase voltage 395,18 V 393,31 V 393,76 V Upp~ = 394,08 V
Angle 120,19 ° 119,91 ° 119,87 ° Uu = 0,00 %
THD-Upp 1,90 % 1,72 % 1,81 %
Energy counters Counter E1 (Exp) Counter E2 (Exp) Counter E3 (Imp) Counter E4 (Imp) Active tariff
Total 1.726.219,60 kWh 294.607,13 kvarh 0,22 kWh 50.941,87 kvarh 1
Tariff 1 1.726.219,55 kWh 294.607,10 kvarh 0,21 kWh 50.941,84 kvarh
Tariff 2 0,00 kWh 0,01 kvarh 0,00 kWh 0,00 kvarh
Measurements
Min/Max
Harmonics Up
Harmonics Upp
Harmonics I
Quality
Alarms
Table view
Graphic view
Recorder

Exemple: Online measurements in tabelaric form

Measurements (online)

Online measurements are available on display or can be monitored with setting and monitoring software MiQen.

Readings on display are performed continuously with refresh time dependent on set average interval whereas rate of readings monitored with MiQen is fixed and refreshed approx. each second.

For better overview over numerous readings, they are divided into several groups, which contain:

basic measurements, min. and max. values, alarms, harmonics (presented groups depend on measurements and function supported in selected device).

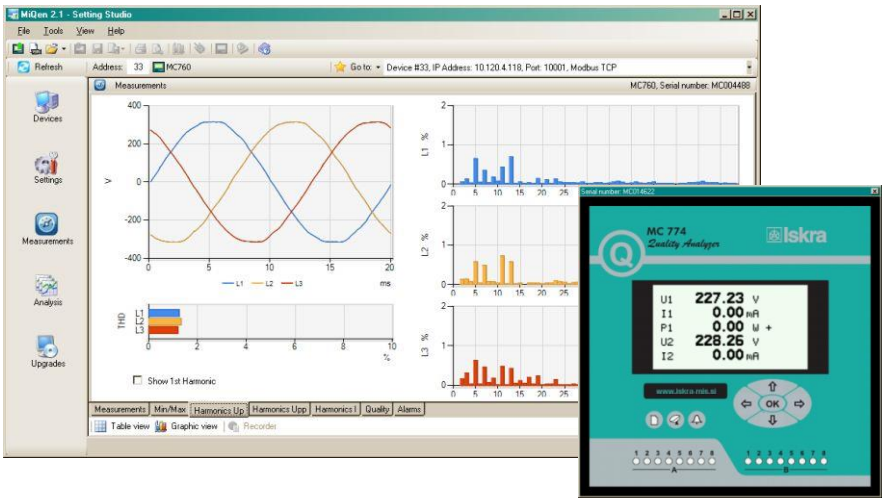
Each group can represent data in visually favoured graphical form or detailed tabelaric form. Latter allows freezing readings and/or copying data into various report generation software tools.

Interactive instrument

Additional communication feature of a device allows interactive handling with a dislocated device as if it would be operational in front of user.

This feature is useful for presentations or product training.

MC774



Online harmonic measurements in graphical form and interactive instrument.

Supported measurements

Selection of supported measurements of individual instrument type is changed with the connection settings. All supported measurements could be read via communication (MiQen) or displayed on display(depends on device hardware).

Available connections

Different electric connections are described more in detail in chapter Electrical connection. Connections are marked as follows:

- Connection 1b (1W) – Single phase connection
- Connection 3b (1W3) – Three-phase – three-wire connection with balanced load
- Connection 4b (1W4) – Three-phase – four-wire connection with balanced load
- Connection 3u (2W3) – Three-phase – three-wire connection with unbalanced load
- Connection 4u (3W4) – Tree-phase – four-wire connection with unbalanced load

PLEASE NOTE

Measurements support depends on connection mode the device type. Calculated measurements (for example voltages U1 and U2 when 3-phase, 4-wire connection with a balanced load is used) are only informative.

Selection of available quantities

Available online measuring quantities and their appearance can vary according to set type of power network and other settings such as; average interval, max. demand mode, reactive power calculation method…

Complete selection of available online measuring quantities is shown in a table on the next page.

PLEASE NOTE

Measurements support depends on connection mode the device type. Calculated measurements (for example voltages U_1 *and* U_2 when 3-phase, 4-wire connection with a balanced load is used) are only informative.

PLEASE NOTE

For 3b and 3u connection mode, only phase to phase voltages are measured. Because of that factor √3 is applied to calculation of quality considering nominal phase voltage. For 4u connection mode measurements support is same as for 1b.

Meas. type	*Measurement*	*3-phase 4-wire*	*3-phase 3-wire*	*1-phase*	*comments*
Phase measurements	*Voltage*				
	$U_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	
	U_{AVG_RMS}	☑	☑	☑	
	$U_{unbalance\_neg\_RMS}$	☑ ☒	☑ ☒		
	$U_{unbalance\_zero\_RMS}$	☒			
	$U_{1\text{-}3\_DC}$	☑	☑	☑ 1ph	*DC component of phase voltages*
	Current				
	$I_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	
	I_{TOT_RMS}	☑	☑	☑	
	I_{AVG_RMS}	☑	☑	☑	
	Power				
	$P_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	
	P_{TOT_RMS}	☑	☑	☑	
	$Q_{1\text{-}3\_RMS}$	☑ ☒	☑ ☒	☑ 1ph ☒	*reactive power can be calculated as a squared difference between S and P or as delayed sample*
	Q_{TOT_RMS}	☑	☑	☑	
	$S_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	
	S_{TOT_RMS}	☑	☑	☑	
	$PF_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	
	$\varphi_{1\text{-}3\_RMS}$	☑	☑	☑ 1ph	PA – Power angle
	Harmonic analysis				
	$THD\text{-}U_{1\text{-}3}$	☑	☑	☑ 1ph	
	$THD\text{-}I_{1\text{-}3}$	☑	☑	☑ 1ph	
	$TDD\text{-}I_{1\text{-}3}$	☑	☑	☑ 1ph	
	$U_{1\text{-}3\_harmonic\_1\text{-}63\_\%}$	☑ ☒	☑ ☒	☑ 1ph ☒	*% of RMS or % of base*
	$U_{1\text{-}3\_harmonic\_1\text{-}63\_ABS}$	☑	☑	☑ 1ph	
	$U_{1\text{-}3\_harmonic\_1\text{-}63\_\varphi}$	☑	☑	☑ 1ph	
	$U_{1\text{-}3\_inter\text{-}harmonic\_\%}$	☑ ☒	☑ ☒	☑ 1ph ☒	*monitoring up to 10 different fixed frequencies. % of RMS or % of base*
	$U_{1\text{-}3\_inter\text{-}harmonic\_ABS}$	☑	☑	☑ 1ph	
	$U_{1\text{-}3\_signaling\_\%}$	☑ ☒	☑ ☒	☑ 1ph ☒	*monitoring of signaling (ripple) voltage of set frequency. % of RMS or % of base*
	$U_{1\text{-}3\_signaling\_ABS}$	☑	☑	☑ 1ph	
	$I_{1\text{-}3\_harmonic\_1\text{-}63\_\%}$	☑ ☒	☑ ☒	☑ 1ph ☒	*% of RMS or % of base*
	$I_{1\text{-}3\_harmonic\_1\text{-}63\_ABS}$	☑	☑	☑ 1ph	
	$I_{1\text{-}3\_harmonic\_1\text{-}63\_\varphi}$	☑	☑	☑ 1ph	
	Flickers				

	Pi_{1-3}	☑	☑	☑ 1ph	*Instantaneous flicker sensation measured with 150 samples / sec (original sampling is 1200 smpl/sec)*
	Pst_{1-3}	☐	☐	☐ 1ph	*10 min statistical evaluation (128 classes of CPF)*
	Plt_{1-3}	☐	☐	☐ 1ph	*derived from 12 Pst acc. to EN 61000-4-15*
	Miscellaneous				
	K-factor$_{1-3}$	☐	☐	☐ 1ph	
	Current Crest factor$_{1-3}$	☐	☐	☐ 1ph	

📖 *Further description is available in following subchapters*

Selection of available measurement quantities

Meas. type	***Measurement***	***3-phase 4-wire***	***3-phase 3-wire***	***1-phase***	***comments***
Phase to phase measurements	*Voltage*				
	Upp_{1-3_RMS}	☐	☐		
	Upp_{AVG_RMS}	☐	☐		
	$THD\text{-}Upp_{1-3}$	☐	☐		
	$\varphi_{x\text{-}y\_RMS}$	☐			*Phase-to-phase angle*
	$Upp_{1-3\_harmonic\_1\text{-}63\_\%}$	☑ ☐	☐ ☐	☑ 1ph ☐	*% of RMS or % of base*
	$Upp_{1-3\_harmonic\_1\text{-}63\_ABS}$	☐	☐	☐ 1ph	
	$Upp_{1-3\_harmonic\_1\text{-}63\_\varphi}$	☐	☐	☐ 1ph	
	$U_{underdeviation}$	☐	☐	☐ 1ph	*Uunder. and Uover. are calculated for phase or phase-to-phase voltages regarding connection mode.*
	$U_{overdeviation}$	☐	☐	☐ 1ph	
Metering	*Energy*	☐	☐	☐	
	Counter E_{1-8}	☐	☐	☐	*each counter can be dedicated to any of four quadrants (P-Q, import-export, L-C). Total energy is a sum of one counter for all tariffs. Tariffs can be fixed, date/time dependent or tariff input dependent*
	$E\_{}_{TOT\_1\text{-}8}$	☐	☐	☐	
	Active tariff	☐	☐	☐	
Auxiliary channel measurements	*Aux. line*				
	$U_{NEUTRAL\text{-}EARTH}$	☐	☐	☐	*aux. voltage is dedicated for neutral-earth meas. only*
	$I_{NEUTRAL\_meas}$	☐	☐	☐	*measured neutral current with* 4^{th} *current input*
	$I_{NEUTRAL\_calc}$	☐	☐	☐	*calculated neutral current*
	$I_{NEUTRAL\_err}$	☐	☐	☐	*error neutral current (difference between measured and calculated)*
Maximum demand measurements	*Maximum demand*				
	MD_I_{1-3}	☐	☐	☐ 1ph	
	MD_P_{import}	☐	☐	☐	

	MD_P_{export}				
	MD_Q_{ind}				
	MD_Q_{cap}				
	MD_S				

📖 *Further description is available in following subchapters*

Selection of available measurement quantities

Meas. type	***Measurement***	***3-phase 4-wire***	***3-phase 3-wire***	***1-phase***	***comments***
Min and max measurements	*Min and max*				
	$U_{1\text{-}3\_RMS\_MIN}$			1 ph	
	$U_{1\text{-}3\_RMS\_MAX}$			1 ph	
	$Upp_{1\text{-}3\_RMS\_MIN}$				
	$Upp_{1\text{-}3\_RMS\_MAX}$				
	$I_{1\text{-}3\_RMS\_MIN}$			1 ph	
	$I_{1\text{-}3\_RMS\_MAX}$			1 ph	
	$P_{1\text{-}3\_RMS\_MIN}$			1 ph	
	$P_{1\text{-}3\_RMS\_MAX}$			1 ph	
	$P_{TOT\_RMS\_MIN}$			1 ph	
	$P_{TOT\_RMS\_MAX}$			1 ph	
	$S_{1\text{-}3\_RMS\_MIN}$			1 ph	
	$S_{1\text{-}3\_RMS\_MAX}$			1 ph	
	$S_{TOT\_RMS\_MIN}$			1 ph	
	$S_{TOT\_RMS\_MAX}$			1 ph	
	$freq_{MIN}$				
	$freq_{MAX}$				
Other measurements	*Miscellaneous*				
	$freq_{MEAN}$				
	Internal temp.				
	Date, Time				
	Last Sync. time				*UTC*
	GPS Time				*If GPS receiver is connected to dedicated RTC time synchronization input*
	GPS Longitude				
	GPS Latitude				
	GPS Altitude				

📖 *Further description is available in following subchapters*

Selection of available measurement quantities

Explanation of basic concepts

Sample frequency

A device measures all primary quantities with a constant sampling rate of 31 kHz (625 sample/per at 50 Hz).

Average interval

Operation of MC774 Quality Analyser depends on several Average intervals, which should all be well understood and set to a proper value.

Average interval for measurements and display

Due to readability of measurements from LCD and communication, an Average interval can be selected from a range of predefined values (from 0.1s to 5 s). The Average interval (see chapter *Average interval*) defines refresh rate of displayed measurements.

Alarms response time is influenced by general average interval if their response time setting is set to “Normal response”. If it is set to “Fast response” alarms depend on a single period measurement.

This average interval has no influence on PQ measurements.

Average interval for min. max. values

Min. and max. values often require special averaging period, which enables or disables detection of short measuring spikes. With this seeting is possible to set averaging from 1 period to 256 periods.

Average (storage) interval for recorders

This storage interval defines a period for writing data into internal memory. It can be set from 1 min to 60 min. At the end of every interval different types of measured data can be stored into recorder (see General purpose recorder settings*)*..

Average (aggregation) interval for PQ parameters

Standard IEC61000-4-30 defines different aggregation intervals and procedures for aggregation of measured PQ parameters.

For each PQ parameter it is possible to set required aggregation interval. Standard aggregation intervals are:

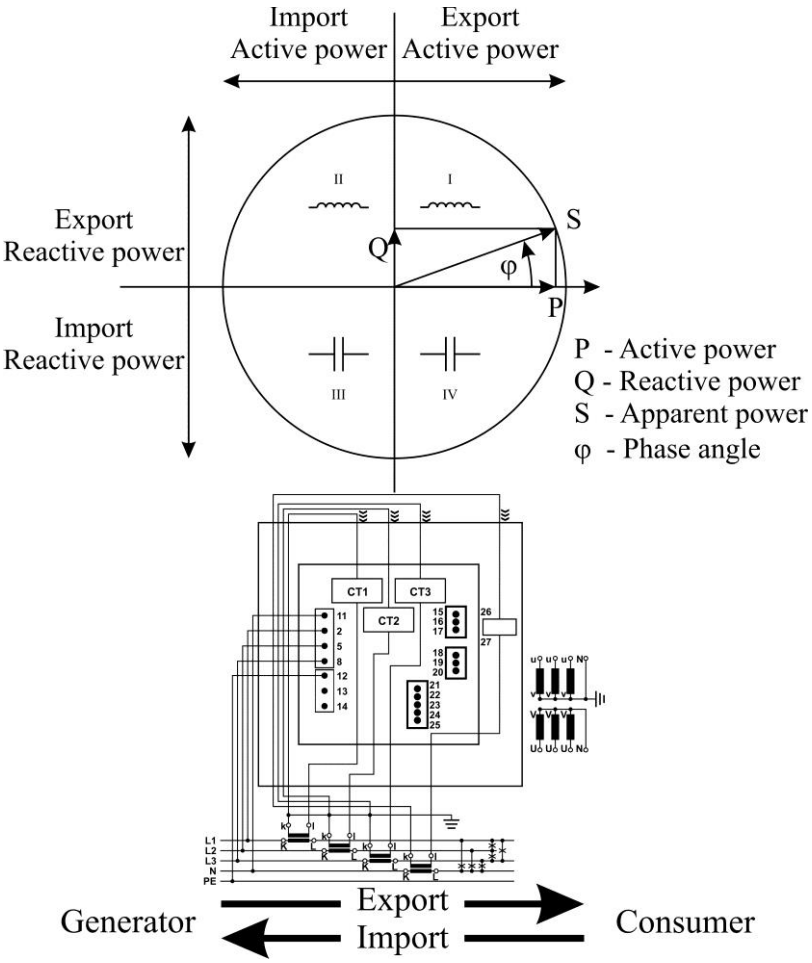
- 10 periods (12 for 60 Hz system)
- 150 periods (180 for 60 Hz system)
- 10 sec
- 10 min (also basic time synchronisation tick interval)
- 2 h

It is also possible to set other aggregation intervals according to requirements. MC774 Quality Analyser supports additional aggregation intervals; 30 sec, 1 min, 15 min, 1 h.

Power and energy flow

Figures below show a flow of active power, reactive power and energy for 4u connection.

Display of energy flow direction can be adjusted to connection and operation requirements by changing the Energy flow direction settings.



Explanation of energy flow direction

Calculation and display of measurements

This chapter deals with capture, calculation and display of all supported quantities of measurement. Only the most important equations are described; however, all of them are shown in a chapter *Equations* with additional descriptions and explanations.

PLEASE NOTE

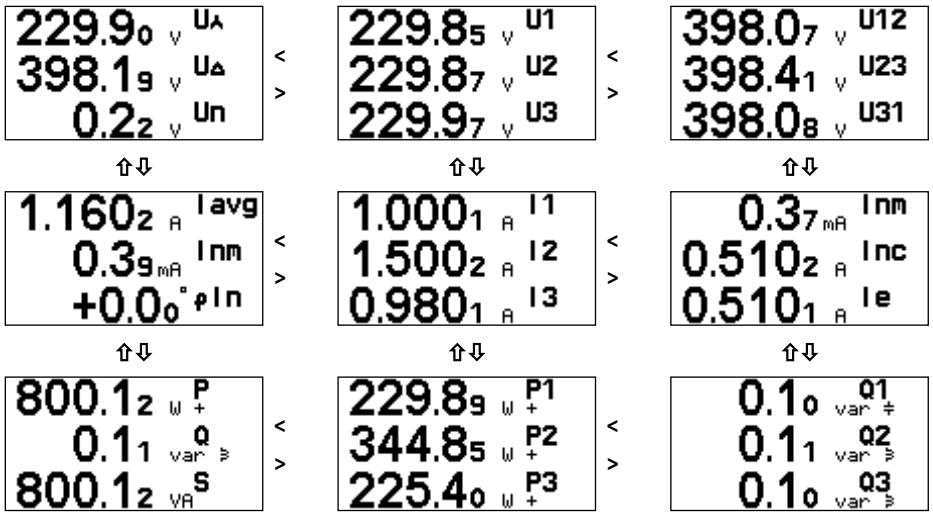
Calculation and display of measurements depend on the connection used. For more detailed information see chapter Survey of supported measurements.

Keyboard and display presentation

For entry and quitting measurements display menu, the **OK** key is used. Direction keys (⇦⇨⇧⇩) are used for passing between displays as show in example below.

Example for 4u connection mode:

Main menu > Measurements > Present values > Voltage



Present values

PLEASE NOTE

Since measurement support depends on connection mode some display groups can be combined in to one, within Measurements menu.

PLEASE NOTE

Display of present values depends on connection mode. Therefore display organisation slightly differs from one connection mode to another.

All measuring instruments may not support all the measurements. Overview of supportive instruments you can see Selection of available measurement quantities.

Voltage

The device measurements:

- real effective (rms) value of all phase voltages (U1, U2, U3), phase-to-phase voltages (U12, U23, U31) and neutral to earth voltage (Un).
- Average phase voltage ($U_{\curlywedge}$) and average phase-to-phase voltage (U_{Δ})
- Negative and zero sequence unbalance ratio (Uu, U_0)
- Phase and phase-to-phase voltage angles (φ1-3, φ12, φ13, φ23)
- Signalling phase and phase-to-phase voltages (Us1-3, Us12, Us13, Us23)
- DC component of phase and phase-to-phase voltages including neutral line

$$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}} \qquad U_{xy} = \sqrt{\frac{\sum_{n=1}^{N} (u_{xn} - u_{yn})^2}{N}}$$

All voltage measurements are available on communication and standard or customized displays on LCD.

Device warns if input signal is too large. In this case signal representation is not correct. Indicator ⇈ is shown above parameter unit:

Main menu > Measurements > Present values > Voltage

Current

Device measures

- real effective (rms) value of phase currents and neutral measured current (Inm), connected to current inputs
- Neutral calculated current (Inc), Neutral error current (Ie = |Inm – Inc|),
- Phase angle between Neutral voltage and Neutral Current (φIn), Average current (Ia) and a sum of all phase currents (It)
- Crest factor of phase currents (CRI1-3)

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

All current measurements are available on communication, standard and customized displays on LCD.

Main menu > Measurements > Present values > Current

Active, reactive and apparent power

Active power is calculated from instantaneous phase voltages and currents. All measurements are seen on communication or are displayed on LCD. For more detailed information about calculation see chapter *Equations.*

There are two different methods of calculating reactive power. See chapter *Reactive power and energy calculation.*.

Device warns if input signal is too large. In this case signal representation is not correct. Indicator is shown above parameter unit:

Main menu > Measurements > Present values > Power

Power factor and power angle

Power angle (or displacement Power Factor) is calculated as quotient of active and apparent power for each phase separately ($\cos\varphi_1$, $\cos\varphi_2$, $\cos\varphi_3$) and total power angle ($\cos\varphi_T$). It represents angle between first (base) voltage harmonic and first (base) current harmonic for each individual phase. Total power angle is calculated from total active and reactive power (see equation for Total power angle, chapter *Equations*). A symbol for a coil (positive sign) represents inductive load and a symbol for a capacitor (negative sign) represents capacitive load.

For correct display of PF via analogue output and application of the alarm, ePF (extended power factor) is applied. It illustrates power factor with one value as described in the table below. For a display on LCD both of them have equal display function: between −1 and −1 with the icon for inductive or capacitive load.

Presentation of extended PF (ePF)

Load	*C*	→		←	L
Angle [°]	−180	−90	0	+90	+180 (179.99)
PF	−1	0	1	0	−1
ePF	−1	0	1	2	3

Example of analogue output for PF and ePF:

Main menu > Measurements > Present values > PF & Power angle

Frequency

Network frequency is calculated from time periods of measured voltage. Instrument uses synchronisation method, which is highly immune to harmonic disturbances.

Device always synchronises to a phase voltage *U1*. If signal on that phase is too low it (re)synchronises to next phase. If all phase voltages are low (e.g. short circuit) device synchronises to phase currents. If there is no signal present on any voltage or current channels, device shows frequency 0 Hz.

Additionally frequency with 10−second averaging interval is displayed.

Main menu > Measurements > Present values > Frequency

Energy counters

Three ways of Energy - counters display are available:

- by individual counter,
- by tariffs for each counter separately and
- energy cost by counter

At a display of measured counter by tariffs, the sum in the upper line depends on the tariffs set in the instrument.

There are two different methods of calculating reactive energy. See chapter *Reactive power and energy calculation.*

Additional information, how to set and define a counter quantity is explained in chapter *ENERGY.*

Main menu > Measurements > Present values > Energy

MD values

MD values and time stamp of occurrence are shown for:

- Three phase currents
- Active powers (import and export)
- Reactive power (ind. and cap.)
- Apparent power

Main menu > Measurements > Present values > MD values

Dynamic demands are continuously calculated according to set time constants and other parameters.

Reset demands are max. values of Dynamic demands since last reset.

Harmonic distortion

Device calculates different harmonic distortion parameters:

- THD is calculated for phase currents, phase voltages and phase−to−phase voltages and is expressed as percent of high harmonic components regarding to fundamental harmonic

Device uses measuring technique of real effective (rms) value that assures exact measurements with the presence of high harmonics up to 63rd harmonic (see chapter *Calculation of harmonics).*

Main menu > Measurements > Present values > THD

Harmonic distortion MC774

Device calculates different harmonic distortion parameters:

- THD is calculated for phase currents, phase voltages and phase−to−phase voltages and is expressed as percent of high harmonic components regarding to fundamental harmonic
- TDD is calculated for phase currents (only MC774)
- K-factor is calculated for phase currents (only MC774)

Device uses measuring technique of real effective (rms) value that assures exact measurements with the presence of high harmonics up to 63rd harmonic (see chapter *Calculation of harmonics).*

Main menu > Measurements > Present values > THD

Customized screens

Here 4 different customised screens are shown. First three screens show 3 different user defined values. Fourth screen displays 5 different values as a combination of 3 values of first screen and first 2 values of second screen.

See chapter *Settings of customized screens.*

Main menu > Measurements > Present values > Custom

WARNING!

When, due to mode of connection, unsupported measurement is selected for customized screen an undefined value is displayed.

Overview

It combines several measurements on each display as the following screens are displayed:

Screen 1:

	Current phase measurements			Current phase measurements	
U	Average voltage $U^{\sim}$	V	P	Total active power P_t	W
1	Phase voltage U_1	V	P1	Active power P_1	W
2	Phase voltage U_2	V	P2	Active power P_2	W
3	Phase voltage U_3	V	P3	Active power P_3	W
I	Average current $I^{\sim}$	A	Q	Total reactive power Q_t	var
1	Current I_1	A	Q1	Reactive power Q_1	var
2	Current I_2	A	Q2	Reactive power Q_1	var
3	Current I_3	A	Q3	Reactive power Q_1	var

Screen 2:

	Current phase-to-phase measurements			Current phase-to-phase measurements	
U	Average phase-to-phase $U^{\sim}$	V		Frequency f	Hz
12	Phase-to-phase voltage U_{12}	V	φ	Power angle φ_1	°
23	Phase-to-phase voltage U_{23}	V	φ	Power angle φ_2	°
31	Phase-to-phase voltage U_{31}	V	φ	Power angle φ_3	°
PF	Total power factor		φ	Average phase-to-phase angle $\varphi^{\sim}$	°
PF1	Power factor PF_1		φ	Power angle φ_{12}	°
PF2	Power factor PF_2		φ	Power angle φ_{23}	°
PF3	Power factor PF_3		φ	Power angle φ_1	°

Screen 3:

	Dynamic MD values			Maximal MD values	
P+	MD active power P (positive)	W		MD active power P (positive)	W
P−	MD active power P (negative)	W	φ	MD active power P (negative)	W
Q	MD reactive power Q−L	var	φ	MD reactive power Q−L	var
Q	MD reactive power Q−C	var	φ	MD reactive power Q−C	var
S	MD apparent power S	VA	φ	MD apparent power S	VA
I1	MD current I1	A	φ	MD current I1	A
I2	MD current I2	A	φ	MD current I2	A
I3	MD current I3	A	φ	MD current I3	A

Example for MC774 at connection 4u:

Main menu ⇨ Measurements ⇨ Present values ⇨ Overview

⇔ ⇔

Min/Max values

All Min/Max values are displayed similar as Present values.

Average interval for min. max. values

Min. and max. values often require special averaging period, which enables or disables detection of short measuring spikes. With this seeting is possible to set averaging from 1 period to 256 periods.

Display of min. and max. values

Present values are displayed with larger font in the middle of the screen, while minimal and maximal values are displayed smaller above and below the present values.

Example of Min/Max screens :

Tabelaric presentation of min. max. values

Graphical presentation of min. max. values

In graphical presentation of min. and max. values relative values are depicted. Base value for relative representation is defined in general settings/Connection mode/used voltage, current range.

For phase voltages and for phase-to-phase voltages the same value is used.

Alarms

Alarms are important feature for notifying exceeded user predefined values. Not only for visualisation and recording certain events with exact time stamp. Alarms can be connected to digital/alarm outputs to trigger different processes (switch closures, line breaking, motors start or stop ...).

It is also very convenient to monitor alarms history. This is enabled on display and even better on communication by using monitoring and setting software MiQen.

Alarm menu on display enables surveying state of ongoing and past alarms.

In the alarm menu, groups of alarms with states of individual alarms are displayed. Also connected alarm outputs are displayed in the bottom line. If displayed alarm output is highlighted means it is active (relay closed). For each active alarm a number of alarms is written in a certain group at a certain place: Group 1: 1■ ■ ■45■ ■ ■8. Dot stands for alarm not active.

In example below there was 1 alarm, which happened under condition defined in Group1/Alarm1 (middle picture). Condition for that alarm was *U1 > 250.00 V* (right picture). Alarm activated Relay output 2 (middle picture, highlighted Out2).

OK **OK**

Alarms: LCD

MC774

Main menu	
Measurements	
Settings	
Resets	
SD card	
Info	
Installation	
14.11.2012	16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

Survey of alarms

In a detailed survey alarms are collected in groups. A number of a group and alarm is stated in the first column, a measurement designation in the second, and a condition for alarm in the third one. Active alarm is marked.

Main menu > Measurements > Alarms OK / >

Tabelaric presentation of alarms

Graphical presentation of alarms

In MiQen software all alarms are presented in tabelaric and graphical form as shown in figures above. For each alarm is shown:

- Group association
- Group Alarm conditions
- Momentary alarm state
- Number of alarm events since last reset

Demonstration measurements

Demo cycling

Regarding the period that is defined in settings, measurement screen cycling is started until any key is pressed.

Main menu ⇒ Measurements ⇒ Demo cycling OK

Harmonic analysis MC774

Main menu	
Measurements	
Settings	
Resets	
SD card	
Info	
Installation	
14.11.2012	16:53:36

⇨

Measurements
Present values
Min/Max values
Alarms
Graphs time
Graphs FFT
Power supply quality
Demo cycling
⇦ Main menu

Harmonic analysis is an important part of PQ monitoring. Frequency converters, inverters, electronic motor drives, LED, halogen and other modern lamps. All this cause harmonic distortion of supply voltage and can influence other sensitive equipment to malfunction or even damage.

In particular vulnerable are distribution level compensation devices whose capacitor banks act like a drain for higher harmonics and amplify their influence. Higher harmonic currents flowing through capacitors can cause overheating and by that shortening their lifetime or even explosions.

Monitoring harmonic distortion is therefore important not only to prevent malfunction of household equipment and to prolong operation of motors but also to prevent serious damage to distribution equipment and to people working close to compensation devices.

Due to importance of harmonic analysis special standard IEC 61000-4-7 defines methods for measurement and calculation of harmonic parameters.

Measuring instrument measures harmonics up to 63rd and evaluates following harmonic parameters:

- Phase Voltage harmonic signals and THD U_{P-N}
- Phase-to-phase Voltage harmonic signals and THD U_{P-P}
- Current harmonic signals and THD I
- TDD total demand distortion for phase currents
- CREST factor for proper dimensioning of connected equipment
- K factor for proper dimensioning of power transformers
- Interharmonics (10 user defined interharmonic values)
- Signalling voltage (monitoring ripple control signal)

PLEASE NOTE

Interharmonics are available only on communication.

All of the listed harmonic parameters can be monitored online, stored in internal memory (where avaliable) (not all at a time) and compared against alarm condition threshold limit.

The latter is in combination with alarm relay output suitable for notification and/or automatic disconnection of compensation devices, when too much harmonics could threaten capacitors.

Display of harmonic parameters

Harmonic parameters can be displayed on devices LCD in graphical form and as a data.

Representation of individual harmonics consists of:

- Absolute value
- Relative value
- Phase angle between base and observed harmonic

PLEASE NOTE

Relative value can be calculated as a percentage of base unit or as a percentage of RMS value. Setting for choice of this relative factor is under General settings (see *Harmonic calculation setting).*

Main menu > Measurements > Graphs time / Graphs FFT

Display of a Phase Voltage in time space diagram. Displayed are also peak value of monitored phase voltage and its RMS value. Similar display is also for phase-to-phase voltages.

Display of a Current in time space diagram. Displayed are also peak value of monitored current and its RMS value

Display of a Phase Voltage in frequency space diagram. Displayed are also RMS value, unit value (100%), system frequency and THD value. Similar display is also for phase-to-phase voltages.

Display of a Current in frequency space diagram. Displayed are also RMS value, unit value (100%), system frequency and THD value.

More information about harmonic parameters, especially individual harmonic values, can be obtained when device is connected to communication and monitoring and setting software MiQen is used.

Tabelaric presentation of phase voltage harmonic components

Graphical presentation of phase voltage harmonic components

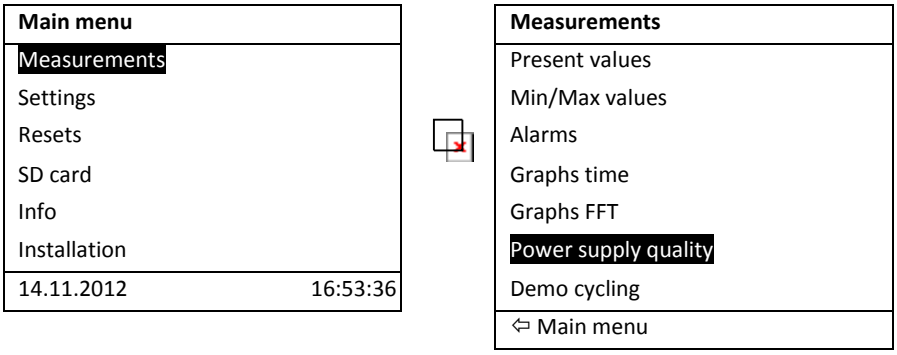
PLEASE NOTE

According to standard IEC 61000-4-7 that defines methods for calculation of harmonic parameters, harmonic values and interharmonic values do not represent signal magnitude at exact harmonic frequency but weighted sum of cantered (harmonic) values and its sidebands. More information can be found in mentioned standard.

Tabelaric presentation of 10 phase voltage interharmonic components

Graphical presentation of phase voltage interharmonic component

PQ Analysis



PQ analysis is a core functionality of ***MC774 Quality Analyser***. PQ (Power Quality) is a very common and well understood expression. However it is not exactly in accordance with its actual meaning.

PQ analysis actually deals with Quality of Supply Voltage. Supply Voltage is a quantity for quality of which utility companies are responsible. It influences behaviour of connected apparatus and devices.

Current and power on the other hand are consequence of different loads and hence responsibility of consumers. With proper filtering load influence can be restricted within consumer internal network or at most within single feeder while poor supply voltage quality influences much wider area.

Therefore indices of supply voltage (alias PQ) are limited to anomalies connected only to supply voltage:

Power Quality indices as defined by EN 50160

Phenomena	*PQ Parameters*
Frequency variations	Frequency distortion
Voltage variations	Voltage fluctuation Voltage unbalance
Voltage changes	Rapid voltage changes Flicker
Voltage events	Voltage dips Voltage interruptions Voltage swells
Harmonics & THD	THD Harmonics Inter-harmonics Signalling voltage

For evaluation of voltage quality, device can store main characteristics in the internal memory. The reports are made on the basis of stored data. Data of the last 300 weeks and up to 170,000 variations of the measured quantities from the standard values are stored in the report, which enables detection of anomalies in the network.

MiQen software offers a complete survey of reports with a detailed survey of individual measured quantities and anomalies. A survey of compliance of individual measured quantities in previous and actual monitored periods is possible.

Online monitoring

When all PQ parameters are set and analysis is enabled (information about settings for PQ analysis can be found in a chapter *Conformity of PQ according to EN 50160*) PQ starts with defined date and starts issuing weekly reports (if monitoring period setting is set to one week).

MiQen software enables monitoring state of actual period and of previous monitoring period. Both periods can be overviewed on a devices display as well.

Main menu > Measurements > Power supply quality > Actual period/Previous period

Example of PQ report for actual period generated on devices display. More detailed information about PQ is available on communication.

Basic information about actual monitoring period. Period is not completed and currently not in compliance with EN

	50160
	Display of current status of PQ parameters. Some are currently not in compliance with EN 50160
	Display of current status of PQ parameters. Some are currently not in compliance with EN 50160
	Display of current status of PQ parameters. Some are currently not in compliance with EN 50160

Online monitoring PQ parameters and over viewing reports is easier with MiQen.

Tabelaric presentation of PQ parameters and overall compliance status for actual and previous monitoring period

For all parameters basic information is shown:

Actual quality

Actual quality is for some parameters expressed as a percentage of time, when parameters were inside limit lines and for others (events) is expressed as a number of events within monitored period.

Actual quality is for some parameters measured in all three phases and for some only in a single phase (frequency). Events can also occur as Multi-Phase events (more about multiphase events is described in following chapters)

Events are according to EN 50160 evaluated on a yearly basis. Actual quality information is therefore combined from two numbers (x / y) as shown in a figure above, where:

X … number of events in monitored period

Y … total number of events in current year

Required quality

Required quality is limit for compliance with standard EN 50160 and is directly compared with actual quality. Result of comparison is actual status of compliance.

More information about required quality limits can be found in standard EN 50160.

PLEASE NOTE

To make the complete quality report the aux. power supply for the device should not be interrupted during the whole period for which the report is requested. If firmware is updated or power supply is interrupted within a monitoring period, quality report is incomplete – Status: Not complete.

Graphical presentation of PQ parameters and overall compliance are available only for actual monitoring period

- Darker green colour marks required quality
- Light green colour marks actual quality
- Red colour marks incompliance with standard EN 50160
- Grey colour at events marks number of events
- MP at events marks Multi phase events

PQ records

Even more detailed description about PQ can be obtained by accessing PQ reports with details about anomalies in internal memory.

Structure and operation of internal memory and instructions on how to access data in internal memory is described in chapters *Device management and Internal memory*).

After memory has been read information about downloaded data is shown.

Information about downloaded data with tabs for different memory partitions

All information about PQ is stored in *Quality reports* tab.

Main window of recorded PQ reports

Main window is divided into two parts. Upper part holds information about recorded periodic PQ reports and lower part holds detailed information about each of upper reports.

For each of monitored parameters it is possible to display anomaly report. This represents a complete list of accurately time stamped measurements that were outside PQ limit lines.

By clicking on "Show details" for each PQ parameter MiQen displays time-stamped measurements (events), which were outside limit lines

Flagged data evaluation

Flagged data represent data (recorded events) that has been flagged (marked) according to flagging concept IEC 61000-4-30.

Flagged data are power quality records, which has been influenced by one or more voltage events (interruptions, dips, swells).

The purpose of flagging data is to mark recorded parameters when certain disturbances might influenced measurements and caused corrupted data. For example, voltage dip can also trigger occurrence of flicker, interharmonics ... In this case all parameters which were recorded at a time of voltage events are marked (flagged).

PQ report will omit or include flagged data according to appropriate setting (see chapter *Flagged events setting.*

PLEASE NOTE

Regardless of this setting, readings will be always stored in recorder and available for analysis. Flagging only influences PQ reports as a whole.

In evaluation of PQ parameter details it is possible to show

- All events
- Non-flagged events

as depicted in a figure below.

Display of all or non-flagged events

Multiphase events

According to standard EN 50160 events (interruptions, dips, swells) should be multiphase aggregated.

Multiphase aggregation is a method where events, which occur in all phases at a same time, are substituted with a single multiphase event since they were most likely triggered by a single anomaly in a network.

However, to eliminate possibility of lose of information all events should be recorded. Therefore during multiphase anomaly four events are recorded. Three events for each phase and an additional multiphase event.

"Phase" column in a list of events marks multiphase event with "-". In this example two events occur in 3rd line and events are multiphase events.

Definition for multiphase dip and swell is:

"*Multiphase event starts when voltage on one or more phases crosses threshold line for event detection and ends when voltage on all phases is restored to normal value"*

Definition for multiphase interruption is:

"*Multiphase interruption starts when voltage on all three phases crosses threshold line for interruption detection and ends when voltage on at least one phase is restored to normal value"*

Graphical presentation of multiphase (PDIP, PINT, PSWL) event detection

Voltage event details are displayed in two ways. First as a list of all events with all details and second in a table according to UNIPEDE DISDIP specifications.

Presentation of Dips and Interruptions in a list (only four events) and in a statistics table

Time graphical display (Graphs time)

All time graphs of measured signals are made in the same way. In the upper part of LCD there is a measurement designation that is followed by a pea-to-peak signal value, and on the extreme right there is RMS value. In the central part of LCD a signal shape is drawn. For a better survey of the measured signal a scale is automatically adapted to the peak-to-peak signal value.

Example:

Main menu > Measurements > Graphs time > Phase voltage OK

OK

Phase voltage

Display of time flow of voltage signals U_1, U_2 and U_3.

Main menu > Measurements > Time graphs > Phase voltage OK / >

Phase-to-phase voltage

Display of time flow of phase-to-phase voltage signals U_{12}, U_{23} and U_{31}.

Main menu > Measurements > Time graphs > Phase–phase voltage OK / >

Current

Display of time flow of current signals I_1, I_2 and I_3.

Main menu > Measurements > Time graphs > Current OK / >

FFT graphical display (Graphs FFT)

All FFT graphs of the measured signals are made in the same way. In the upper right angle of LCD the following measurements are stated:

- Designation of measurement with current RMS value
- Value of first harmonic
- Current frequency
- THD signal value

The remaining part is used for a (bar) graphic display of relative values of harmonics regarding the first one. For better resolution, first harmonic is not displayed and rating is automatically adapted according to highest harmonic values.

Example:

Main menu > Measurements > Graphs FFT > Phase voltage OK

OK

Phase voltage

Display of harmonics of phase voltage signals U_1, U_2 and U_3.

Main menu > Measurements > Time FFT > Phase voltage OK / >

Phase-to-phase voltage

Display of harmonics phase-to-phase voltage signals U_{12}, U_{23} and U_{31}.

Main menu > Measurements > Time FFT > Phase−phase voltage OK / >

Current

Display of harmonics of current signals I_1, I_2 and I_3.

Main menu > Measurements > Time FFT > Current OK / >

Demonstration measurements

Demo cycling

Regarding the period that is defined in settings, measurement screen cycling is started until any key is pressed.

Main menu > Measurements > Demo cycling OK

TEHNICAL DATA

In following chapter all technical data regarding operation of device is presented.

Accuracy MC774

Measured values	*Measuring Range (Direct connection)*	*Accuracy class*	
		Standard	*Class*
Active power	1.8 – 18 kW (In = 5 A)	IEC61557-12	0.2
	0 – 1.8 kW (In = 1 A)	IEC61557-12	0.5
Reactive power	0 – 18 kvar	IEC61557-12	1
Apparent power	0 – 18 kVA	IEC61557-12	0.2
Active energy	9 digit	IEC61557-12	0.2S
Reactive energy	9 digit	IEC61557-12	2
Apparent energy	9 digit	IEC61557-12	0.2
Rms current (I_1, I_2, I_3, *Iavg*) (I_{n_meas}) (I_{n_calc})	0,001 to 12.5 Arms In = 1 A or 5A In = 1 A or 5A[1] In = 1 A or 5A	IEC61557-12	 0.1 0.2 0.5
Rms phase voltage (U_1, U_2, U_3, U_{n-g}, U_{avg})	U_{meas}:10 - 600 V $_{L-N}$ U_{din} = 120/230V	IEC61557-12 IEC61000-4-30	0.1 Class A
Rms phase-to-phase voltage (U_{12}, U_{23}, U_{31}, U_{avg})	18 - 1000 V $_{L-L}$	IEC61557-12 IEC61000-4-30	0.1 Class A
Voltage negative sequence unbalance [2] (u_2)	10 - 600 V $_{L-N}$	IEC61557-12 IEC61000-4-30	0.2 Class A
Voltage zero sequence unbalance [2] (u_0)	10 - 600 V $_{L-N}$	IEC61557-12 IEC61000-4-30	0.2 Class A
Voltage flicker (*Pst, Plt*)	0.2 Pst – 10 Pst	IEC61000-4-15 IEC61000-4-30	Class F1 [2] Class A
Frequency – actual (f)	50 / 60Hz	IEC61557-12 IEC61000-4-30	0.02 Class A
Frequency - (10 s average) (f_{10s})	50 / 60 Hz	IEC61557-12 IEC61000-4-30	0.02 Class A
Nominal frequency range	16…400 Hz	IEC61557-12	0.02

Measured values	*Measuring Range (Direct connection)*	*Accuracy class*	
		Standard	*Class*
Power factor (PF_A)	−1(C)…0…+1(L)	IEC61557-12	0.5
Voltage swells (U_{swl})	100 – 120 % U_{din}	IEC61557-12 IEC61000-4-30	0.2, ±1 cyc Class A
Volatge dips (U_{dip})	5 – 100 % U_{din}	IEC61557-12 IEC61000-4-30	0.2, ±1 cyc Class A
Voltage interruptions (U_{int})	0 – 5 % U_{din}	IEC61557-12 IEC61000-4-30	±1 cyc Class A
THDU(3)	10 – 200% of IEC61000-4-2 Class 3 Up to 4kHz	IEC61557-12 IEC61000-4-7 IEC61000-4-30	0.3 Class I Class A
Voltage harmonics ($U_{h\_l\text{-}n}$, $U_{h\_l\text{-}l}$)	10 – 200% of IEC61000-4-2 Class 3 Up to 4kHz (63rd)	IEC61557-12 IEC61000-4-7 IEC61000-4-30	0.15 Class I Class A
Voltage interharmonics (U_{Ih})	10 – 200% of IEC61000-4-2 Class 3	IEC61000-4-7 IEC61000-4-30	Class I Class A
THDI(4)	Up to 4kHz	IEC61557-12	0.3
Current harmonics (I_h)	Up to 4kHz (63rd)	IEC61557-12	0.5
Signalling voltage (U_{msv})	Up to 3kHz	IEC61000-4-30	Class A
Real time clock (RTC)	synchronised unsynchronised	IEC61000-4-30	Class A < ±1 sec/day

(1) Accurate measurements of neutral current (I_{n_meas}) at lower frequencies (16Hz – 30Hz) are possible up to 6Arms
(2) Voltage unbalance is measured as amplitude and phase unbalance U_{nb}
(3) Test specifications for flickermeter according to standard IEC61000-4-15:2010
(4) When measuring THD, user can set how it is calculated (as a % of fundamental or as a % from RMS value)

Inputs MC774

Voltage input		
	Number of channels	4 (1)
	Sampling rate	31 kHz
	Min. voltage for sync.	1 V_{rms}
	Nominal value (U_N)	500 V_{LN} , 866 V_{LL}
	Max. measured value (cont.)	600 V_{LN} ; 1000 V_{LL}
	Max. allowed value	1.2 × U_N permanently
		2 × U_N ; 10 s
	Consumption	< U^2 / 4.2 MΩ per phase
	Input impedance	4.2 MΩ per phase
	(1) 4th channel is used for measuring $U_{EARTH-NEUTRAL}$	
Current input		
	Number of channels	4
	Sampling rate	31 kHz
	Nominal value (I_N)	1A, 5 A
	Max. measured value	12.5 A sinusoidal
	Max. allowed value (thermal)	15 A cont.
		≤ 300 A; 1s
	Consumption	< I^2 × 0.01Ω per phase
Frequency		
	Nominal frequency (f_n)	50, 60 Hz
	Measuring range	16…400 Hz
Supply		
	Standard (high):	CAT III 300V
	Nominal voltage AC	80 … 276 V
	Nominal frequency	40 … 65 Hz
	Nominal voltage DC	70 … 300 V
	Consumption (max. all I/O)	< 8VA
	Power-on transient current	< 20 A; 1 ms
	Optional (low):	CAT III 300V
	Nominal voltage AC	48 … 77 V
	Nominal frequency	40 … 65 Hz
	Nominal voltage DC	19 … 70 V
	Consumption (max. all I/O)	< 8VA
	Power-on transient current	< 20 A; 1 ms

Connection MC774

Permitted conductor cross-sections

Terminals	Max. conductor cross-sections	
Voltage inputs (4)	2,5 mm^2	with pin terminal
	4 mm^2	solid wire
Current inputs (4)	≤ Ø 6 mm	one conductor with insulation[1]
Supply (3)	2,5 mm^2	with pin terminal
	4 mm^2	solid wire
Modules 1, 2 (2 x 3)	2,5 mm^2	with pin terminal
	4 mm^2	solid wire
Modules A, B (2 x 9)	2,5 mm^2	with pin terminal
	4 mm^2	solid wire
Module C (1 x 7)	2,5 mm^2	with pin terminal
	4 mm^2	solid wire

[1] Insulation for current connection wire should be at least PVC with 4kV dielectric strength and at least +75 °C working temperature (+100°C short time; <1 min)

WARNING

It is imperative that terminal 12 which represents fourth voltage measurement channel is connected to earth pole ONLY. This terminal should be connected to EARTH potential at all times!

Communication MC774

	Ethernet	USB	RS232	RS485
Type of connection	Network	Direct		Network
Max. connection length	30 m	2m	3 m	1000 m
Terminals	RJ−45	USB - B	Screw terminals	
Insulation	In accordance with EN 61010−1:2010 standard			
Transfer mode	Asynchronous			
Protocol	MODBUS TCP / DNP3 auto detect	MODBUS RTU / DNP3 auto detect		
Transfer rate	10/100Mb/s	2.400 to 115.200 bit/s		

I/O Modules MC774

Digital input module	Main module (1, 2)	
	Purpose	Tariff input, Pulse input, General purpose digital input
	Tariff input	
	No. of inputs per module	2
	Rated voltage	5 ... 48 V AC/DC *
		110 ±20% V AC/DC *
		230 ±20% V AC/DC *
		* Depends on a built in hardware
	Frequency range	45…65 Hz
	Pulse input	
	No. of inputs per module	2
	Rated voltage	5 – 48 V DC (±20%)
	Max. Current	8 mA (at 48 V DC + 20%
	Min. pulse width	0.5 ms
	Min. pulse period	2 ms
	SET voltage	40 ... 120 % of rated voltage
	RESET voltage	0 ... 10 % of rated voltage
	General purpose digital input	
	No. of inputs per module	2
	Voltage	5 ... 48 V AC/DC *
		110 ±20% V AC/DC *
		230 ±20% V AC/DC *
		* Depends on built in hardware
	Auxiliary module (A, B)	
	Purpose	General purpose digital input
	No. of inputs per module	8
	Voltage	5 ... 48 V AC/DC *
		110 ±20% V AC/DC *
		230 ±20% V AC/DC *
		* Depends on built in hardware
Digital output module	Main module (1, 2)	
	Type	*Relay switch*
	No. of outputs per module	2
	Purpose	Alarm output, General purpose digital output
	Rated voltage	230 VAC/DC ± 20% max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24V)
	Impulse	Max. 4000 imp/hour
		Min. length 100 ms
	Type	Bistable Relay switch
	No. of outputs per module	1
	Purpose	Alarm output, General purpose digital output

	Max. switching power	40 VA
	Rated voltage	230 $V_{AC/DC}$ ± 20% max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24V)

Digital output module	Type	Optocoupler open collector switch
	No. of outputs per module	2
	Purpose	Pulse output
	Rated voltage	40 VAC/DC
	Max. switching current	30 mA (RONmax = 8Ω)
	Pulse length	programmable (2 … 999 ms)
	Auxiliary module (A, B)	
	Type	*Relay switch*
	No. of outputs per module	8
	Purpose	Alarm output, General purpose digital output
	Rated voltage	230 VAC/DC ± 20% max
	Max. switching current	100 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24V)
Status (Watchdog) output module	Type	Relay switch
	Number of outputs	1 x watchdog + 1 x relay output
	Normal operation	Relay in ON position
	Failure detection delay	≈ 1.5 s
	Rated voltage	230 $V_{AC/DC}$ ±20% max
	Max. switching current	1000 mA
	Contact resistance	≤ 100 mΩ (100 mA, 24V)
Analogue output module	Output range	0…20 mA
	Accuracy	0.5% of range
	Max. burden	150 Ω
	Linearization	Linear, Quadratic
	No. of break points	5
	Output value limits	± 120% of nominal output
	Response time (measurement and analogue output)	depends on set general average interval (0.1s – 5s)
	Residual ripple	< 1 % p.p.
Time sync. input module C	Digital input	GPS or IRIG-B TTL
	1pps voltage level	TTL level (+5V)
	Max. consumption on +5V terminal	100 mA

Time code telegram	RS232 (GPS)
	DC level shif (IRIG-B)
AM analog input	IRIG-B AM modulated
Carrier frequency	1 kHz
Input impedance	600 Ohms
Amplitude	2.5VP-Pmin, 8VP-Pmax
Modulation ration	3:1 – 6:1

ž		
DC current input	Nominal input range 1	–20 … 0 … 20 mA (±20%)
	input resistance	20 Ω
	accuracy	0.5 % of range
	temperature drift	0.01% / °C
	conversion resolution	16 bit (sigma-delta) internally referenced
	Analogue input mode	Single-ended
DC voltage input	Nominal input range1	–10 … 0 … 10 V (±20%)
	input resistance	100 kΩ
	accuracy	0.5 % of range
	temperature drift	0.01% / °C
	conversion resolution	16 bit (sigma-delta)
		internally referenced
	Analogue input mode	Single-ended
Resistance/ temperature Input module	Nominal input range (low)*	0 - 200 Ω (max. 400 Ω)
		PT100 (-200°C–850°C)
	Nominal input range (high)*	0 – 2 kΩ (max. 4 kΩ)
		PT1000 (-200°C–850°C)
	connection	2-wire
	accuracy	0.5 % of range
	conversion resolution	16 bit (sigma-delta)
		internally referenced
	Analogue input mode	Single-ended

* Low or high input range and primary input value (resistance or temperature) are set by the MiQen setting software

Safety

Safety τ σ	protection class II In compliance with EN 61010−1:2010 600 V rms, installation category II 300 V rms, installation category III Pollution degree 2
Test voltage	Uaux against SELV circuits - 3.51 kV rms Other circuits to functional earth – 2.21 kV rms
EMC	Directive on electromagnetic compatibility 2004/108/EC In compliance with EN 61326-1:2006 for industrial environment
Protection	In compliance with EN 60529: 1997/A1:2000 Front side (with protection cover for memory slot): IP40 Rear side (with protection cover): IP20

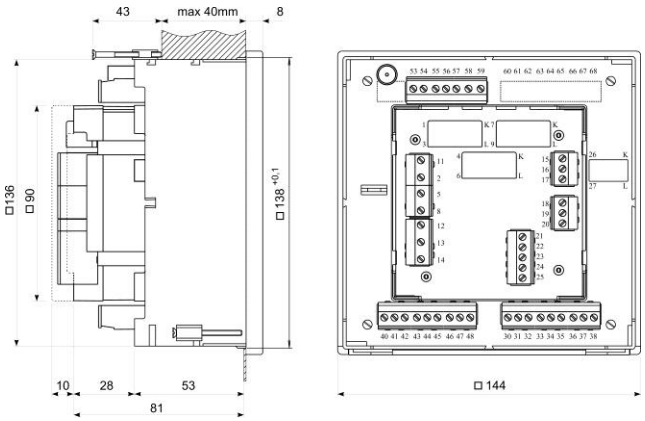
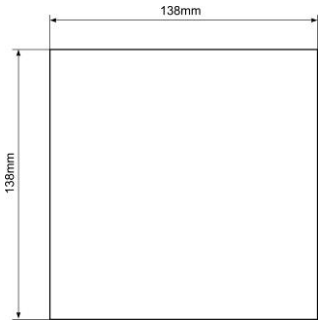
Operating conditions

Operating conditions which have been tested for proper operation of a device within specified accuracy are in accordance with requirements in standards IEC61557-12, IEC61326-1, IEC61000-4-30 and IEC61000-4-7

Ambient conditions		
	Ambient temperature	K55 temperature class Acc. to EN 61557-12 -10 … 55 °C
	Storage temperature range	-40 to +70 °C
	Ambient humidity	≤ 75% r.h. (no condensation)
	Max. storage and transport humidity	≤ 90% r.h. (no condensation)
	Voltage and Current max. temperature influence limit	± 20 ppm / K (10V-600V; 0,05A-10A) (T_{amb} : -30°C to +70°C)
Influence of Auxiliary Supply		
	Voltage and Current max. aux. supply change influence limit (IEC61557-12)	< ± 0,02 % (Supply voltage magnitude and frequency in a specified range)
	Common mode input voltage rejection (IEC61557-12)	< ± 0,08 % (common mode voltage at 500V)
Influence of EMC		
	External A.C. field IEC61326-1	< ±0,02 % Performance criteria A
	Electrostatic discharges IEC61326-1	(IEC61000-4-2) Performance criteria B
	Electromagnetic RF fields IEC61326-1	(IEC61000-4-3) Limit 1%; < ±0,4 % [(a)] Performance criteria A
	Conducted disturbances IEC61326-1	(IEC61000-4-6) Limit 1%; < ±0,4 % [(a)] Performance criteria A
	[(a)] Test performed my measuring active energy with pulse output. Error (0.4%) is due to short measuring time	

Dimensions

Dimensional drawing

Construction	*Appearance*
Dimensions	All dimensions are in mm 
Panel cut-out	
Enclosure	

Dimensions	144 × 144 ×100 mm
Mounting	Panel mounting 144×144 mm
Required mounting hole	137 × 137 mm
Enclosure material	PC/ABS
Flammability	Acc. to UL 94 V-0
Weight	550 g
Enclosure material	PC/ABS

APENDICES

APPENDIX A: MODBUS communication protocol

Communication protocols

Modbus and DNP3 protocol are enabled via RS232 and RS485 or Ethernet communication. Both communication protocols are supported on all communication ports of the device. The response is the same type as the request.

Modbus

Modbus protocol enables operation of device on Modbus networks. For device with serial communication the Modbus protocol enables point to point (for example Device to PC) communication via RS232 communication and multi drop communication via RS485 communication. Modbus protocol is a widely supported open interconnect originally designed by Modicon.

In this document main modbus registers are listed. For complete, latest, Modbus table please visit ISKRA SISTEMI web site.

The memory reference for input and holding registers is 30000 and 40000 respectively.

PLEASE NOTE

For the latest and complete MODBUS table please visit Iskra Sistemi web page.

Register table for the actual measurements

Parameter	MODBUS		
	Register		Type
	Start	End	
Actual time	30101	30104	T_Time
Frequency	30105	30106	T5
Voltage U_1	30107	30108	T5
Voltage U_2	30109	30110	T5
Voltage U_3	30111	30112	T5
Average phase Voltage $U_{\sim}$	30113	30114	T5
Phase to phase voltage U_{12}	30118	30119	T5
Phase to phase voltage U_{23}	30120	30121	T5
Phase to phase voltage U_{31}	30122	30123	T5
Average phase to phase Voltage $U_{pp\sim}$	30124	30125	T5
Voltage neutral to ground $Uno_{\sim}$	30485	30486	T5
Current I_1	30126	30127	T5
Current I_2	30128	30129	T5
Current I_3	30130	30131	T5
Neutral Current Inc (calculated)	30132	30133	T5
Neutral Current Inm (measured)	30134	30135	T5
Average Current	30136	30137	T5
Total Current I	30138	30139	T5
Real Power P_1	30142	30143	T6
Real Power P_2	30144	30145	T6
Real Power P_3	30146	30147	T6
Total Real Power P	30140	30141	T6
Reactive Power Q1	30150	30151	T6
Reactive Power Q2	30152	30153	T6
Reactive Power Q3	30154	30155	T6
Total Reactive Power Q	30148	30149	T6
Apparent Power S1	30158	30159	T5
Apparent Power S2	30160	30161	T5
Apparent Power S3	30162	30163	T5
Total Apparent Power S	30156	30157	T5

Register table for the actual measurements cont.

Parameter	MODBUS		
	Register		Type
	Start	End	
Power Factor PF1	30166	30167	T7
Power Factor PF2	30168	30169	T7
Power Factor PF3	30170	30171	T7
Total Power Factor PF	30164	30165	T7
Power Angle U1−I1	30173		T17
Power Angle U2−I2	30174		T17
Power Angle U3−I3	30175		T17
Angle between In and Un	30488		T17
Power Angle atan2(Pt, Qt)	30172		T17
Angle U1−U2	30115		T17
Angle U2−U3	30116		T17
Angle U3−U1	30117		T17
Angle Un−U1	30487		T17
Voltage unbalance Uu	30176		T16
Voltage unb. zero sequence Uo	30177		T16
U1 Signal voltage Abs	30592	30593	T5
U2 Signal voltage Abs	30594	30595	T5
U2 Signal voltage Abs	30596	30597	T5
THD I1	30188		T16
THD I2	30189		T16
THD I3	30190		T16
THD U1	30182		T16
THD U2	30183		T16
THD U3	30184		T16
THD U12	30185		T16
THD U23	30186		T16
THD U31	30187		T16
Internal Temperature	30181		T2

Register table for the actual measurements cont.

Parameter	MODBUS Register		Type
	Start	End	
Max Demand Since Last RESET			
MD Real Power P (positive)	30542	30543	T6
MD Real Power P (negative)	30548	30549	T6
MD Reactive Power Q – L	30554	30555	T6
MD Reactive Power Q – C	30560	30561	T6
MD Apparent Power S	30536	30537	T5
MD Current I1	30518	30519	T5
MD Current I2	30524	30525	T5
MD Current I3	30530	30531	T5
Dynamic Demand Values			
MD Real Power P (positive)	30510	30511	T6
MD Real Power P (negative)	30512	30513	T6
MD Reactive Power Q – L	30514	30515	T6
MD Reactive Power Q – C	30516	30517	T6
MD Apparent Power S	30508	30509	T5
MD Current I1	30502	30503	T5
MD Current I2	30504	30505	T5
MD Current I3	30506	30507	T5

Actual counter is calculated:
Cnt.× 10 ^{exponent}

Register table for the actual measurements cont.

Parameter	MODBUS Register Start	End	Type
Energy			
Energy Counter 1 Exponent	30401		T2
Energy Counter 2 Exponent	30402		T2
Energy Counter 3 Exponent	30403		T2
Energy Counter 4 Exponent	30404		T2
Counter E1	30406	30407	T3
Counter E2	30408	30409	T3
Counter E3	30410	30411	T3
Counter E4	30412	30413	T3
Counter E1 Tariff 1	30414	30415	T3
Counter E2 Tariff 1	30416	30417	T3
Counter E3 Tariff 1	30418	30419	T3
Counter E4 Tariff 1	30420	30421	T3
Counter E1 Tariff 2	30422	30423	T3
Counter E2 Tariff 2	30424	30425	T3
Counter E3 Tariff 2	30426	30427	T3
Counter E4 Tariff 2	30428	30429	T3
Counter E1 Tariff 3	30430	30431	T3
Counter E2 Tariff 3	30432	30433	T3
Counter E3 Tariff 3	30434	30435	T3
Counter E4 Tariff 3	30436	30437	T3
Counter E1 Tariff 4	30438	30439	T3
Counter E2 Tariff 4	30440	30441	T3
Counter E3 Tariff 4	30442	30443	T3
Counter E4 Tariff 4	30444	30445	T3
Counter E1 Cost	30446	30447	T3
Counter E2 Cost	30448	30449	T3
Counter E3 Cost	30450	30451	T3
Counter E4 Cost	30452	30453	T3
Active tariff	30405		T1

Register table for the actual measurements cont.

Parameter	MODBUS Register Start	MODBUS Register End	Type
Flickers			
Flicker Pst1	30580		T17
Flicker Pst2	30581		T17
Flicker Pst3	30582		T17
Flicker Plt1	30583		T17
Flicker Plt2	30584		T17
Flicker Plt3	30585		T17
Flicker Pf5 - L1	30586	30587	T5
Flicker Pf5 - L2	30588	30589	T5
Flicker Pf5 - L3	30590	30591	T5
Phase voltage harmonic data			
U1 Harmonic Data			
Base for % calculation	31001	31002	T5
U1 1 Harmonic Abs %	31003		T16
U1 1 Harmonic Phase Angle	31004		T17
U1 Harmonics from 2 to 62			
U1 63 Harmonic Abs %	31127		T16
U1 63 Harmonic Phase Angle	31128		T17
U2 Harmonic Data			
Base for % calculation	31129	31130	T5
U2 1 Harmonic Abs %	31131		T16
U2 1 Harmonic Phase Angle	31132		T17
U2 Harmonics from 2 to 62			
U2 63 Harmonic Abs %	31255		T16
U2 63 Harmonic Phase Angle	31256		T17
U3 Harmonic Data			
Base for % calculation	31257	31258	T5
U3 2 Harmonic Abs %	31259		T16
U3 2 Harmonic Phase Angle	31260		T17
U3 Harmonics from 3rd to 30th			
U3 63 Harmonic Abs %	31383		T16
U3 63 Harmonic Phase Angle	31384		T17

Register table for the actual measurements cont.

Parameter	MODBUS Register Start	MODBUS Register End	Type
Line voltage harmonic data			
U12 Harmonic Data			
Base for % calculation	31385	31386	T5
U12 1 Harmonic Abs %	31387		T16
U12 1 Harmonic Phase Angle	31388		T17
U12 Harmonics from 2 to 62			
U12 63 Harmonic Abs %	31511		T16
U12 63 Harmonic Phase Angle	31512		T17
U23 Harmonic Data			
Base for % calculation	31513	31514	T5
U23 1 Harmonic Abs %	31515		T16
U23 1 Harmonic Phase Angle	31516		T17
U23 Harmonics from 2 to 62			
U23 63 Harmonic Abs %	31639		T16
U23 63 Harmonic Phase Angle	31640		T17
U31 Harmonic Data			
Base for % calculation	31641	31642	T5
U31 2 Harmonic Abs %	31643		T16
U31 2 Harmonic Phase Angle	31644		T17
U31 Harmonics from 3rd to 30th			
U31 63 Harmonic Abs %	31767		T16
U31 63 Harmonic Phase Angle	31768		T17

Register table for the actual measurements cont.

Parameter	MODBUS Register Start	MODBUS Register End	Type
Phase current harmonic data			
I1 Harmonic Data			
Base for % calculation	31769	31770	T5
I1 1 Harmonic Abs %	31771		T16
I1 1 Harmonic Phase Angle	31772		T17
I1 Harmonics from 2 to 62			
I1 63 Harmonic Abs %	31895		T16
I1 63 Harmonic Phase Angle	31896		T17
I2 Harmonic Data			
Base for % calculation	31897	31898	T5
I2 1 Harmonic Abs %	31899		T16
I2 1 Harmonic Phase Angle	31900		T17
I2 Harmonics from 2 to 62			
I2 63 Harmonic Abs %	32023		T16
I2 63 Harmonic Phase Angle	32024		T17
I3 Harmonic Data			
Base for % calculation	32025	32026	T5
I3 2 Harmonic Abs %	32027		T16
I3 2 Harmonic Phase Angle	32028		T17
I3 Harmonics from 3rd to 30th			
I3 63 Harmonic Abs %	32151		T16
I3 63 Harmonic Phase Angle	32152		T17

Register table for the actual measurements cont.

Parameter	MODBUS Register Start	MODBUS Register End	Type
Phase voltage interharmonic data			
U1 Interharmonic Data			
Base for % calculation	32153	32154	T5
1. Interharmonic Abs %	32155		T16
2. Interharmonic Abs %	32156		T16
3. - 10 Interharmonic	32157	32164	T16
U2 Interharmonic Data			
Base for % calculation	3271	3272	T5
1. Interharmonic Abs %	32173		T16
2. Interharmonic Abs %	32174		T16
3. - 10 Interharmonic	32175	32182	T16
U3 Interharmonic Data			
Base for % calculation	32189	32190	T5
1. Interharmonic Abs %	32191		T16
2. Interharmonic Abs %	32192		T16
3. - 10 Interharmonic	32193	32200	T16

All other MODBUS regiters are a subject to change. For the latest MODBUS register defenitions go to ISKRA web page www.iskra.eu

Register table for the basic settings

Register	Content	Type	Ind	Values / Dependencies	Min	Max	Pass. Level
40143	Connection Mode	T1	0	No mode	1	5	2
			1	1b - Single Phase			
			2	3b - 3 phase 3 wire balanced			
			3	4b - 3 phase 4 wire balanced			
			4	3u - 3 phase 3 wire unbalanced			
			5	4u - 3 phase 4 wire unbalanced			
40144	CT Secondary	T4		mA			2
40145	CT Primary	T4		A/10			2
40146	VT Secondary	T4		mV			2
40147	VT Primary	T4		V/10			2
40148	Current input range (%)	T16		10000 for 100%	5,00	200,00	2
40149	Voltage input range (%)	T16		10000 for 100%	2,50	100,00	2
40150	Frequency nominal value	T1		Hz	10	1000	2

Data types decoding

Type	Bit mask	Description
T1		Unsigned Value (16 bit) Example: 12345 = 3039(16)
T2		Signed Value (16 bit) Example: -12345 = CFC7(16)
T3		Signed Long Value (32 bit) Example: 123456789 = 075B CD 15(16)
T4	bits # 15…14 bits # 13…00	Short Unsigned float (16 bit) Decade Exponent(Unsigned 2 bit) Binary Unsigned Value (14 bit) Example: 10000*102 = A710(16)
T5	bits # 31…24 bits # 23…00	Unsigned Measurement (32 bit) Decade Exponent(Signed 8 bit) Binary Unsigned Value (24 bit) Example: 123456*10-3 = FD01 E240(16)
T6	bits # 31…24 bits # 23…00	Signed Measurement (32 bit) Decade Exponent (Signed 8 bit) Binary Signed value (24 bit) Example: - 123456*10-3 = FDFE 1DC0(16)
T7	bits # 31…24 bits # 23…16 bits # 15…00	Power Factor (32 bit) Sign: Import/Export (00/FF) Sign: Inductive/Capacitive (00/FF) Unsigned Value (16 bit), 4 decimal places Example: 0.9876 CAP = 00FF 2694(16)
T9	bits # 31…24 bits # 23…16 bits # 15…08 bits # 07…00	Time (32 bit) 1/100s 00 - 99 (BCD) Seconds 00 - 59 (BCD) Minutes 00 - 59 (BCD) Hours 00 - 24 (BCD) Example: 15:42:03.75 = 7503 4215(16)

Data types decoding cont.

Type	Bit mask	Description
T10	bits # 31…24 bits # 23…16 bits # 15…00	Date (32 bit) Day of month 01 - 31 (BCD) Month of year 01 - 12 (BCD) Year (unsigned integer) 1998..4095 Example: 10, SEP 2000 = 1009 07D0(16)
T16		Unsigned Value (16 bit), 2 decimal places Example: 123.45 = 3039(16)
T17		Signed Value (16 bit), 2 decimal places Example: -123.45 = CFC7(16)
T_float	bits # 31 bits # 31 bits # 31	IEEE 754 Floating-Point Single Precision Value (32bit) Sign Bit (1 bit) Exponent Field (8 bit) Significand (23 bit) Example: 123.45 stored as 123.45000 = 42F6 E666(16)
T_Str4		Text: 4 characters (2 characters for 16 bit register)
T_Str6		Text: 6 characters (2 characters for 16 bit register)
T_Str8		Text: 8 characters (2 characters for 16 bit register)
T_Str16		Text: 16 characters (2 characters for 16 bit register)
T_Str40		Text: 40 characters (2 characters for 16 bit register)

APPENDIX B: DNP3 communication protocol

Communication protocols

Modbus and DNP3 protocol are enabled via RS232 and RS485 or Ethernet communication. Both communication protocols are supported on all communication ports of the device. The response is the same type as the request.

DNP3

DNP3 protocol enables operation of a device on DNP3 networks. For device with serial communication the DNP3 protocol enables point to point (for example device to PC) communication via RS232 communication and multi drop communication via RS485.

Device automatically responses to MODBUS or DNP3 request.

PLEASE NOTE

For the latest and complete DNP3 table please visit Iskra Sistemi web page.

DNP 3.0
Device Profile Document

Issue: E
Date: 8 Jan 2013

Device Name: Measurement centre
Vendor Name: Iskra d.d.
Models Covered: MC774

Highest DNP Level Supported:	Device Function:
For Requests: 1	☐ Master
For Responses: 1	☐ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the DNP V3.0 Implementation table).

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted: 292	Transmitted: 2048
Received: 249	Received: 249
Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None	☐ None
☐ Configurable	☐ Configurable

Requires Data Link Layer Confirmation:
☐ Never
☐ Always
☐ Sometimes
☐ Configurable

Requires Application Layer Confirmation:
☐ Never
☐ Always
☐ Sometimes
☐ Configurable

Timeouts while waiting for:
Data Link Confirm: ☐ None ☐ Fixed at ____ ☐ Variable ☐ Configurable
Complete Appl. Fragment: ☐ None ☐ Fixed at ____ ☐ Variable ☐ Configurable
Application Confirm: ☐ None ☐ Fixed at ____ ☐ Variable ☐ Configurable
Complete Appl. Response: ☐ None ☐ Fixed at ____ ☐ Variable ☐ Configurable
Others:

Sends/Executes Control Operations:
WRITE Binary Outputs Never Always Sometimes Configurable
SELECT/OPERATE Never Always Sometimes Configurable
DIRECT OPERATE Never Always Sometimes Configurable
DIRECT OPERATE – NO ACK Never Always Sometimes Configurable

Count > 1 Never Always Sometimes Configurable
Pulse On Never Always Sometimes Configurable
Pulse Off Never Always Sometimes Configurable
Latch On Never Always Sometimes Configurable
Latch Off Never Always Sometimes Configurable

Queue Never Always Sometimes Configurable
Clear Queue Never Always Sometimes Configurable

Reports Binary Input Change Events when no specific variation requested: Never Only non-time-tagged Configurable	Reports time-tagged Binary Input Change Events when no specific variation requested: Never Binary Input Change With Relative Time Configurable
Sends Unsolicited Responses: Never Configurable Only certain Objects Sometimes ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: Never When Device Restarts When Status Flags Change No other options are permitted.
Default Counter Object/Variation: No Counters Reported Configurable Default Object: 30 Default Variation: 4 Point-by-point list attached	Counters Roll Over at: No Counters Reported Configurable 16 Bits 32 Bits Other Value: 20000 Point-by-point list attached
Sends Multi-Fragment Responses: Yes No	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
0	242	Device Attributes - software version	1	0	129	00, 17
0	243	Device Attributes – hardware version	1	0	129	00, 17
0	246	Device Attributes – user assigned ID	1	0	129	00, 17
0	248	Device Attributes – serial number	1	0	129	00, 17
0	250	Device Attributes – product name	1	0	129	00, 17
0	252	Device Attributes – manufacture name	1	0	129	00, 17
0	254	Device Attributes – nonspecific all attributes request	1	00, 06		
0	255	Device Attributes – list of attribute variation	1	00, 06	129	00, 5B
Points for object 0						
0	Software version	T_Str3	Data	var	242	
0	Hardware version	T_Str2	Data	var	243	
0	user assigned ID	T_Str2	Data	var	246	
0	serial number	T_Str8	Data	var	248	
0	product name	T_Str16	Data	var	250	
0	manufacture name	T_Str20	Data	var	252	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
10	0	Binary output status	1	00, 01, 06		
10	2	Binary output status	1	00, 01, 06	129	00, 01
Points for object 10						
0	Relay 1	T1	Data	0	1	
1	Relay 2	T1	Data	0	1	
2	Relay 3	T1	Data	0	1	
3	Relay 4	T1	Data	0	1	
4	Slot A - Relay 1	T1	Data	0	1	
5	Slot A - Relay 2	T1	Data	0	1	
6	Slot A - Relay 3	T1	Data	0	1	
7	Slot A - Relay 4	T1	Data	0	1	
8	Slot A - Relay 5	T1	Data	0	1	
9	Slot A - Relay 6	T1	Data	0	1	
10	Slot A - Relay 7	T1	Data	0	1	
11	Slot A - Relay 8	T1	Data	0	1	
12	Slot B - Relay 1	T1	Data	0	1	
13	Slot B - Relay 2	T1	Data	0	1	
14	Slot B - Relay 3	T1	Data	0	1	
15	Slot B - Relay 4	T1	Data	0	1	
16	Slot B - Relay 5	T1	Data	0	1	
17	Slot B - Relay 6	T1	Data	0	1	
18	Slot B - Relay 7	T1	Data	0	1	
19	Slot B - Relay 8	T1	Data	0	1	

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
30	0	16-Bit Analog Input without flag	1	00, 01, 06		
30	2	16-Bit Analog Input with flag	1	00, 01, 06	129	00, 01
30	4	16-Bit Analog Input without flag	1	00, 01, 06	129	00, 01

Points for object 30							
0	U1	T16		Data	-Un	+Un	
1	U2	T16		Data	-Un	+Un	
2	U3	T16		Data	-Un	+Un	
3	Uavg (phase to neutral)	T16		Data	-Un	+Un	
4	U12	T16		Data	-Un	+Un	
5	U23	T16		Data	-Un	+Un	
6	U31	T16		Data	-Un	+Un	
7	Uavg (phase to phase)	T16		Data	-Un	+Un	
8	I1	T16		Data	-In	+In	
9	I2	T16		Data	-In	+In	
10	I3	T16		Data	-In	+In	
11	I total	T16		Data	-In	+In	
12	I neutral (calculated)	T16		Data	-In	+In	
13	I neutral (measured)	T16		Data	-In	+In	
14	Iavg	T16		Data	-In	+In	
15	Active Power Phase L1 (P1)	T17		Data	-Pn	+Pn	
16	Active Power Phase L2 (P2)	T17		Data	-Pn	+Pn	
17	Active Power Phase L3 (P3)	T17		Data	-Pn	+Pn	
18	Active Power Total (Pt)	T17		Data	-Pt	+Pt	
19	Reactive Power Phase L1 (Q1)	T17		Data	-Pn	+Pn	
20	Reactive Power Phase L2 (Q2)	T17		Data	-Pn	+Pn	
21	Reactive Power Phase L3 (Q3)	T17		Data	-Pn	+Pn	
22	Reactive Power Total (Qt)	T17		Data	-Pt	+Pt	
23	Apparent Power Phase L1 (S1)	T16		Data	-Pn	+Pn	
24	Apparent Power Phase L2 (S2)	T16		Data	-Pn	+Pn	
25	Apparent Power Phase L3 (S3)	T16		Data	-Pn	+Pn	
26	Apparent Power Total (St)	T16		Data	-Pt	+Pt	
27	Power Factor Phase 1 (PF1)	T17		Data	-1	1	
28	Power Factor Phase 2 (PF2)	T17		Data	-1	1	
29	Power Factor Phase 3 (PF3)	T17		Data	-1	1	

Points for object 30 cont.							
30	Power Factor Total (PFt)	T17		Data	-1	1	
31	CAP/IND P. F. Phase 1 (PF1)	T17		Data	-1 CAP	+1	300% for -1 IND
32	CAP/IND P. F. Phase 2 (PF2)	T17		Data	-1 CAP	+1	300% for -1 IND
33	CAP/IND P. F. Phase 3 (PF3)	T17		Data	-1 CAP	+1	300% for -1 IND
34	CAP/IND P. F. Total (PFt)	T17		Data	-1 CAP	+1	300% for -1 IND
35	j1 (angle between U1 and I1)	T17		Data	-100°	+100°	
36	j 2 (angle between U2 and I2)	T17		Data	-100°	+100°	
37	j 3 (angle between U3 and I3)	T17		Data	-100°	+100°	
38	Power Angle Total (atan2(Pt,Qt))	T17		Data	-100°	+100°	
39	j 12 (angle between U1 and U2)	T17		Data	-100°	+100°	
40	j 23 (angle between U2 and U3)	T17		Data	-100°	+100°	
41	j 31 (angle between U3 and U1)	T17		Data	-100°	+100°	
42	Frequency	T17		Data	Fn-10Hz	Fn+10Hz	
43	U unbalace	T16		Data	-100%	100%	
44	I1 THD%	T16		Data	-100%	100%	
45	I2 THD%	T16		Data	-100%	100%	
46	I3 THD%	T16		Data	-100%	100%	
47	U1 THD%	T16		Data	-100%	100%	
48	U2 THD%	T16		Data	-100%	100%	
49	U3 THD%	T16		Data	-100%	100%	
50	U12 THD%	T16		Data	-100%	100%	

51	U23 THD%	T16		Data	-100%	100%	
52	U31 THD%	T16		Data	-100%	100%	
	MAX DEMAND SINCE LAST RESET						
53	Active Power Total (Pt) - (positive)	T16		Data	-Pt	+Pt	
54	Active Power Total (Pt) - (negative)	T16		Data	-Pt	+Pt	
55	Reactive Power Total (Qt) - L	T16		Data	-Pt	+Pt	
56	Reactive Power Total (Qt) - C	T16		Data	-Pt	+Pt	
57	Apparent Power Total (St)	T16		Data	-Pt	+Pt	
58	I1	T16		Data	-In	+In	
59	I2	T16		Data	-In	+In	
60	I3	T16		Data	-In	+In	
	DYNAMIC DEMAND VALUES						
61	Active Power Total (Pt) - (positive)	T16		Data	-Pt	+Pt	

Active Power Total (Pt) - (negative)	T16		Data	-Pt	+Pt	
Reactive Power Total (Qt) - L	T16		Data	-Pt	+Pt	
Reactive Power Total (Qt) - C	T16		Data	-Pt	+Pt	
Apparent Power Total (St)	T16		Data	-Pt	+Pt	
I1	T16		Data	-In	+In	
I2	T16		Data	-In	+In	
I3	T16		Data	-In	+In	
ENERGY						
Energy Counter 1	T17		Data			(32-bit value) MOD 20000
Energy Counter 2	T17		Data			(32-bit value) MOD 20000
Energy Counter 3	T17		Data			(32-bit value) MOD 20000
Energy Counter 4	T17		Data			(32-bit value) MOD 20000
Energy Counter 1 Cost	T17		Data			(32-bit value) MOD 20000
Energy Counter 2 Cost	T17		Data			(32-bit value) MOD 20000
Energy Counter 3 Cost	T17		Data			(32-bit value) MOD 20000
Energy Counter 4 Cost	T17		Data			(32-bit value) MOD 20000
Total Energy Counter Cost	T17		Data			(32-bit value) MOD 20000
Aktiv Tariff	T1		Data			
Internal Temperature	T17		Data	-100°	+100°	

Object				Request		Response	
Object Number	Variation Number	Description		Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
40	0	16-bit Analog output status		1	00, 01, 06		
40	2	16-bit Analog output status		1	00, 01, 06	129	00, 01
Points for object 40							
0	Analog output 1	T1		Data	0		
1	Analog output 2	T1		Data	0		
2	Analog output 3	T1		Data	0		
3	Analog output 4	T1		Data	0		
4	Slot A - Analog output 1	T1		Data	0		
5	Slot A - Analog output 2	T1		Data	0		
6	Slot A - Analog output 3	T1		Data	0		
7	Slot A - Analog output 4	T1		Data	0		
8	Slot B - Analog output 1	T1		Data	0		
9	Slot B - Analog output 2	T1		Data	0		
10	Slot B - Analog output 3	T1		Data	0		
11	Slot B - Analog output 4	T1		Data	0		

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
50	0	Time and Date – absolute time	2	7		
50	1	Time and Date – absolute time	2	7	129	7
Points for object 50						
0	Time and Date	T_Time	Data			

Object			Request		Response	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
60	1	CLASS 0 DATA	1	6		
60	2	CLASS 1 DATA	1,22*	6		
60	3	CLASS 2 DATA	1,22*	6		
60	4	CLASS 3 DATA	1,22*	6		

*only object 30

APPENDIX C: EQUATIONS

Definitions of symbols

No	Symbol	Definition
1	M_P	Average interval
2	U_f	Phase voltage (U_1, U_2 or U_3)
3	U_{ff}	Phase-to-phase voltage (U_{12}, U_{23} or U_{31})
4	N	Total number of samples in a period
5	n	Sample number ($0 \le n \le N$)
6	x, y	Phase number (1, 2 or 3)
7	i_n	Current sample n
8	u_{fn}	Phase voltage sample n
9	u_{fFn}	Phase-to-phase voltage sample n
10	φ_f	Power angle between current and phase voltage f (φ_1, φ_2 or φ_3)
11	U_u	Voltage unbalance
12	U_c	Agreed supply voltage

Voltage

$U_f = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$	***Phase voltage*** N - samples in averaging interval (up to 65 Hz)
$U_{xy} = \sqrt{\frac{\sum_{n=1}^{N} (u_{xn} - u_{yn})^2}{N}}$	***Phase-to-phase voltage*** u_x, u_y - phase voltages (U_f) N - a number of samples in averaging interval
$U_u = \sqrt{\frac{1-\sqrt{3-6\beta}}{1+\sqrt{3-6\beta}}} \cdot 100\%$ $\beta = \frac{U_{12fund}^4 + U_{23fund}^4 + U_{31fund}^4}{(U_{12fund}^2 + U_{23fund}^2 + U_{31fund}^2)^2}$	***Voltage unbalance*** U_{fund} - first harmonic of phase-to-phase voltage

Current

$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$	***Phase current*** N - samples in averaging interval (up to 65 Hz)
$I_n = \sqrt{\frac{\sum_{n=1}^{N} (i_{1n} + i_{2n} + i_{3n})^2}{N}}$	***Neutral current*** i - n sample of phase current (1, 2 or 3) N - samples in averaging interval (up to 65 Hz)

Power

$P_f = \frac{1}{N} \cdot \sum_{n=1}^{N} (u_n \cdot i_n)$	***Active power by phases*** N - a number of periods n - index of sample in a period f - phase designation
$P_t = P_1 + P_2 + P_3$	***Total active power*** t - total power 1, 2, 3 - phase designation
$SignQ_f(\varphi)$ $\varphi \in [0° - 180°] \Rightarrow SignQ_f(\varphi) = +1$ $\varphi \in [180° - 360°] \Rightarrow SignQ_f(\varphi) = -1$	***Reactive power sign*** Q_f - reactive power (by phases) ? - power angle
$S_f = U_f \cdot I_f$	***Apparent power by phases*** U_f - phase voltage I_f - phase current
$S_t = S_1 + S_2 + S_3$	***Total apparent power*** S_f - apparent power by phases
$Q_f = SignQ_f(\varphi) \cdot \sqrt{S_f^2 - P_f^2}$	***Reactive power by phases*** S_f - apparent power by phases P_f - active power by phases
$Q_f = \frac{1}{N} \cdot \sum_{n=1}^{N} \left(u_{f\,n} \times i_{f\,[n+N/4]} \right)$	***Reactive power by phases (displacement method)*** N - a number of samples in a period n - sample number (0 ? n ? N) f - phase designation
$Q_t = Q_1 + Q_2 + Q_3$	***Total reactive power*** Q_f - reactive power by phases
$\varphi_t = \arctan 2(P_t, Q_t)$ $\varphi_t = [-180°, 179{,}99°]$	***Total power angle*** P_t - total active power Q_t - total reactive power
$PF_t = \frac{P_t}{S_t}$	***Distortion*** **factor** P_t - total active power S_t - total apparent power
$PF_f = \frac{P_f}{S_f}$	***Distortion factor*** P_f - phase active power S_f - phase apparent power

THD, TDD

$I_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^2}}{I_1} \cdot 100$	***Current THD*** I_1 - value of first harmonic n - number of harmonic
$I_f TDD(\%) = \frac{\sqrt{\sum_{n=2}^{63} I_n^2}}{I_L} \cdot 100$	***Current TDD*** I_L - value of max. load current (fixed, user defined value) n - number of harmonic
$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^2}}{U_{f1}} \cdot 100$	***Phase voltage THD*** U_1 - value of first harmonic n - number of harmonic
$U_f THD(\%) = \frac{\sqrt{\sum_{n=2}^{63} U_{fn}^2}}{U_{f1}} \cdot 100$	***Phase-to-phase voltage THD*** U_1 - value of first harmonic n - number of harmonic

Current factors

$CFI(\%) = \frac{I_{PEAK}}{I_{RMS}} \cdot 100$	***CREST factor*** I_{RMS} – RMS value of phase current I_{PEAK} – Peak value of current within cycle
$K_i = \frac{\sum_{n=1}^{63} (I_n \times n)^2}{\sum_{n=1}^{63} I_n^2}$	***K factor*** I_L - value of max. load current (fixed, user defined value) n - number of harmonic

Flickers

$P_{50S} = (P_{30} + P_{50} + P_{80})/3$ $P_{10S} = (P_6 + P_8 + P_{10} + P_{12} + P_{17})/5$ $P_{2S} = (P_{2,2} + P_3 + P_4)/3$ $P_{1S} = (P_{1,7} + P_1 + P_{1,5})/3$ $P_{st} = \sqrt{0{,}0314P_{0,1} + 00525P_{1S} + 0{,}0657P_{2S} + 0{,}28P_{10S} + 0{,}08P_{50S}}$	***Pst - Short-term flicker intensity*** Short-term flicker intensity is measured in 10 minute periods. P_x - flicker levels that are exceeded by x% in a 10-minute period (e.g. $P_{0,1}$ represents a flicker level that is exceeded by 0.1% samples)
$P_{lt} = \sqrt[3]{\sum_{i=1}^{12} \frac{P_{sti}^3}{12}}$	***Plt - Long-term flicker intensity*** Calculated from twelve successive values of short-term flicker intensity in a two-hour period

Energy

$\text{Price in tariff} = \text{Price} \cdot 10^{\text{Tariff price exponent}}$	Total exponent of tariff price and energy price in all tariffs

APPENDIX D: XML DATA FORMAT

Explanation of XML data format

All data, which is prepared to be sent at next time interval is combined into element <*data*>. It comprises of elements <*value*>, which contain all information regarding every single reading.

Attributes of element <*value*> are:

- *logId*: Identification code of data package. It is used as a confirmation key and should therefore be unique for each device.
- *app*: application type ??
- *storeType:* data type ("measurement" or “alarm”) or quality report??
- *dataProvider*: "xml001" ??
- *controlUnit*: Serial number of the device that sent this data
- *part*: rekorder ??
- *datetimeUTC*: UTC date and time of the beginning of current time interval in which data was sent (yyyy-mm-dd hh:mm:ss).
- *ident*: ID code of particular reading
- *tFunc*: thermal function (1= ON / 0 = OFF)
- *cond*: condition (1 = lower than; 0 = higher then)
- *condVal*: limit value
- *almNum*: alarm serial number.
- *unit*: Measuring Parameter Unit (V, A, VA, W, VAr …)
- *tInterval:* sampling interval in minutes
- *dst: (*daylight savings time) in minutes
- *tzone:* timezone in minutes

Example of alarms <data> package

<data logId="033350088" app="ML" storeType="alarm" dataProvider="xml001" controlUnit="MC004475" part="E" datetimeUTC="2009-07-15 21:29:07" dst="60" tzone=" 60">

<value ident="U1 " unit="V " tFunc="0" cond="0" condVal="200,00" almNum="01">100</value>

<value ident="U2 " unit="V " tFunc="0" cond="0" condVal="200,00" almNum="02">101</value>

<value ident="U3 " unit="V " tFunc="0" cond="0" condVal="200,00" almNum="03">99</value>

</data>

Example of readings <data> package

<data logId="033324218" app="ML" storeType="measurement" dataProvider="xml001" controlUnit="MC004475" part="B" datetimeUTC="2009-09-16 3:00:00" dst="60" tzone=" 60" tInterval="015">

<value ident="U1 " unit="V ">234,47</value>
<value ident="U2 " unit="V ">234,87</value>
<value ident="U3 " unit="V ">234,52</value>
<value ident="I1 " unit="A ">1,14</value>
<value ident="I2 " unit="A ">1,50</value>
<value ident="I3 " unit="A ">3,58</value>
<value ident="P1 " unit="W ">-0,063e+03</value>
<value ident="P2 " unit="W ">-0,101e+03</value>
<value ident="P3 " unit="W ">0,281e+03</value>
<value ident="P " unit="W ">0,11e+03</value>
<value ident="Q " unit="var ">-1,37e+03</value>
<value ident="E1 " unit="Wh">19620e+01</value>
<value ident="E2 " unit="varh">6e+01</value>
<value ident="E3 " unit="Wh">1303391e+01</value>
<value ident="E4 " unit="varh">2999595e+01</value>
<value ident="ePF " unit=" ">0,0820</value>
</data>

Example of acknowledgement package:

<ack logId="033220002" datetimeUTC ="2008-01-31 23:00:50:000"></ack>

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